DOCUMENT RESUME

ED 023 610 SE 005 588

By-Fredrickson, Clifford T.
Guide for Teaching Science Problems 1-2, Grade XI or XII. Second Edition.
San Diego City Schools, Calif.
Pub Date 66
Note-267p.
EDRS Price MF-$1.00 HC-$13.45
Descriptors-Course Descriptions, *Curriculum, Evaluation, *General Science, Grade 11, Grade 12, Instruction, Instructional Materials, *Low Ability Students, Objectives, Science Activities, Science Equipment, *Secondary School Science, *Teaching Guides
Identifiers-California, San Diego City Schools

Science Problems 1-2 is a terminal course for eleventh and twelfth grade students with limited science background and generally below average reading levels. The guide is intended as a supplement to the detailed teacher's guide prepared by the publishers of the textbook used in the course. It is assumed that no teacher is expert in all subject matter areas covered in the course. Therefore, each unit in the guide contains detailed sections on learning objectives, text and supplementary references for specific topics, resource materials, audio-visual materials, in-school materials, classroom activities, and an evaluation sheet for feedback from the teacher. A lengthy appendix contains maps, charts, worksheets, and laboratory exercises. Topics in the course include the nature of science, matter and energy, the atmosphere, the hydrosphere, the lithosphere, plants and animals, the human body, energy and machines, and astronomy. (BC)

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GUIDE FOR TEACHING SCIENCE PROBLEMS 1-2

Grade XI or XII

ED023610

SE 005 183

San Diego City Schools
San Diego, California
1958
Second Edition, 1966

GUIDE FOR TEACHING SCIENCE PROBLEMS 1-2

Grade XI or XII

Prepared

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San Diego City Schools
San Diego, California
1958
Second Edition, 1966
Unedited

PREFACE

The second edition of the Guide for Teaching Science Problems 1-2 is a complete revision of the 1958 publication which it supersedes.

The need for the revision was brought about by a major reorganization of the course content and changes in emphasis recommended by the Committee of Science Problems Teachers which met during the 1965-66 school year. The Committee developed criteria for selection of a new basic textbook for the course and evaluated numerous books submitted by publishers. Following the selection and adoption of Herron and Palmer's Matter, Life and Energy, 1965 as the new basic textbook, the Committee recommended the preparation of the new guide and submitted suggested materials to be included therein.

It is hoped that this publication and the newly adopted textbook and associated materials will provide effective guidelines and resource materials for student and teacher achievement of a stimulating and meaningful science experience.

This unedited copy will be revised at the end of the school year 1966-67. Evaluations should be made regularly on the form provided at the end of each unit. These should be sent along with any suggested experiments, worksheets, and the like to the Science Specialist, Curriculum Services Division, by the end of this school year in June 1967.

Wm. H. Stegeman

William H. Stegeman
Assistant Superintendent
Curriculum Services Division

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POINT OF VIEW

The world of today is intimately concerned with science in both its direct and indirect application. One of the problems of modern education is that of providing students with an understanding and appreciation of science in daily living. They must be adequately informed regarding their bio-chemo-physical environment and their relationship to it as living organisms. They should understand how this environment affects their physical and mental well-being and how their home life and daily living are affected individually as well as on a community basis. They should appreciate the contributions of science to good living on a national and world basis.

This course entitled "Science Problems: 1-2" is planned for students at the eleventh and twelfth-grade level and particularly for those who are non-college preparatory. They will need a practical understanding of science and the methods of the scientist in order to fill their places as citizens in a civilization which has become increasingly dependent upon the practical applications of scientific knowledge. They will need this knowledge in order to establish and keep in good health, exercise intelligent buying, use modern home appliances, function intelligently in their different fields of work, be effective in civic affairs and to improve recreational activities. They need to be able to understand and evaluate advertising, newspaper and magazine articles, books, speeches, TV and radio programs. A good citizen needs a knowledge as well as an appreciation of the role of the scientist for intelligent participation in deciding on many controversial issues.

The educational task in the course in Science Problems is admittedly not that of educating scientists, nor is it designed to furnish a background for further formal education in fields of science education. The purpose is rather to provide high school students with such education as will better prepare them for successful living and intelligent citizenship. The course should give them a foundation of knowledge of the practical basic principles upon which they can build an understanding of the future daily science developments and advances. To accomplish this purpose the course includes a broad coverage of the fields of life and physical sciences. The students will engage in activities which will help them understand how scientists work, and learn of the impact of the scientists' accomplishments in society. They will also have an opportunity to apply their study of science to practical problems of everyday life.

INTRODUCTION

Composition of the Class

Science Problems 1-2 is a terminal course in science for 11th and 12th grade students with no formal science background required. The student with a background of biology and/or chemistry would profit more from an additional college preparatory science offering and should not be enrolled in this course. The student enrolled in Science Problems 1-2 has normally completed only the one-semester required course in science at grade 8 and is usually taking the course to meet the requirements for high school graduation. His reading level is generally below the 50th percentile and he has not displayed special interest or capabilities in science.

Content and Use of the Guide

The publishers of the basic textbook have provided a teachers' guide which will assist the teacher in planning the day-to-day discussion activities. The Guide to Science Problems 1-2 is intended to complement the commercial publication by assisting the instructor in making full use of the wide variety of resources and materials available in San Diego. It is anticipated that the teacher will have major subject matter training in either life sciences, chemistry or physics and will probably not be an expert in all of the areas included in the science problems course. The guide will attempt, therefore, to provide information and material of such a nature as to be especially useful to the science teacher in teaching the units that are not consistent with his major field.

The following is included for each unit and/or chapter:

LEARNING OBJECTIVES as suggested by the authors of the basic text.

TEXT AND SUPPLEMENTARY TEXT REFERENCES related to the specific topic.

RESOURCE MATERIALS of a special nature including teacher handbooks, free and inexpensive materials, etc.

AUDIO-VISUAL MATERIALS are available from San Diego City Schools Instructional Aids Center.

IN-SCHOOL MATERIALS normally available from Biology, Chemistry, Physics, or custodian.

CLASSROOM ACTIVITIES including materials and ideas as follows:
- Suggested Laboratory Exercises
- Discussion Suggestions
- Activities Suggestions

EVALUATION SHEET for feedback of suggestions by teachers.

The Appendix in the guide contains maps, charts, worksheets and laboratory exercises. These sheets may be used as masters for the production of transparencies and/or spirit-duplicator masters. The teacher will find it practical to reproduce most of these sheets for distribution on a one-per-student basis. It is suggested that the guide be kept in a B-ring binder to facilitate removal and replacement of existing sheets and the addition of new materials.

The units designated in the guide as optional are those which have been explored quite thoroughly in Science 8, which is a required course at Grade 8 in San Diego City Schools. If time allows, and/or if student interest is high, more extensive and up-to-date study of these topics is appropriate.

COURSE DESCRIPTION*

SCIENCE PROBLEMS 1-2 (Two-semester course--Grades 11 or 12 - no prerequisites)

This is an elective course designed primarily for those who need to fulfill the high school graduation requirements. It is not intended for students who have completed biology or chemistry. It may be elected by those who have had only: (1) General Science 1-2 or, (2) Basic Biology 1-2, and wish to continue the study of science to include more of the physical sciences.

Areas of emphasis and time allotments:	Weeks
The Nature of Science	1-2
Matter and Energy	2-3
The Atmosphere	2-3
The Hydrosphere	3-4
The Lithosphere (optional)	2-3
Plants and Animals	4-5
The Human Body	4-5
Energy and Machines	2-3
Heat Energy	2-3
Wave Energy	3-4
Electrical Energy	1-2
Electronics	1-2
Nuclear Energy	1-2
The Earth in Space (optional)	1-2
Astronomy and Astronautics (optional)	2-3

Basic Text: Herron and Palmer, Matter, Life, and Energy, 1965

Supplementary Texts:

Brooks, et al., Modern Physical Science, 1966
Fitzpatrick, et al., Living Things, 1966
Herron and Palmer, Study Guide and Laboratory Activities for Matter, Life, and Energy, 1965
Smith and Lisonbee, Your Biology, 2nd Edition, 1962

Teacher Guides:

Guide for Science Problems 1-2, 2nd Edition, 1966 (Stock No. 41-S-2000)
Herron and Palmer, Matter, Life, and Energy, Teacher's Guide, 1965
Handbook of Science Laboratory Practices and Safety, (Stock No. 41-L-0500)

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*San Diego City Schools Digest of Secondary School Curriculum, published annually, San Diego, California.

GENERAL OBJECTIVES

Science teaching at the secondary school level should attempt to help each student make as much progress toward the following general objectives as he can with a maximum benefit and satisfaction to himself. The science student who is growing in science understandings--

1. Makes unbiased decisions after critically observing and evaluating all pertinent evidence.
2. Is aware of the role of science in economic and social progress.
3. Distinguishes between science and superstition or pseudo-science and between facts and propaganda.
4. Reads and critically evaluates articles and news items of scientific interest.
5. Takes positive attitude toward the conservation of natural resources.
6. Improves his health habits by applying his knowledge of science.
7. Makes use of his scientific knowledge and the habit of critical judgment to improve his consumer practices.
8. Spends leisure time more effectively because of broadened interest or science-related hobbies.
9. Considers the opportunities offered in the field of science when choosing his vocation.
10. Acquires, through experience in laboratory work, habits of neatness and accuracy, resourcefulness in the use of equipment, and skill in manipulation and coordination.
11. Learns to seek by himself and discover for himself the answers to his problems.

GENERAL TEACHING PROCEDURES

Teaching Techniques

Instruction in this course as in all science courses should emphasize the active participation of students in discussions, planning, demonstrations, investigation and experimentation. Many resources such as books, laboratory materials, films, filmstrips, worksheets, laboratory exercises, reports, projects and guest speakers should be used to provide a variety of experiences designed to stimulate the interests and imagination of student and teacher alike.

Homework

A regular and reasonable amount of out-of-class work is necessary in order to provide adequate coverage of topics and to maintain the students activity and interest. Textbook reading, notebook work, special reports, setting up demonstrations or experiments, and so forth can generally be considered out-of-class work. This procedure is recommended and should be expected of eleventh and twelfth grade students.

Student Notebook

Each student should keep a notebook as a means of organizing and recording information learned in the course. The notebook may contain such things as: discussion notes, worksheets, write-ups of experiments and demonstrations, notes on films, and other pertinent information.

Such required activities on the part of students should be checked or graded periodically. Neatness (but not artistic ability), originality, promptness, completeness, accuracy, effort, understanding, and problem-solving approach should be considered in grading the notebook.

Keeping the notebook should facilitate learning and should not involve so much time as to limit the materials covered or methods used. The notebook is only one part of the total learning situation involving many methods and materials.

Student Laboratory Experiences

The guide provides numerous suggestions for classroom demonstrations. It is obviously not possible to use all of them and the teacher must choose those which he deems most appropriate. Some of these may be modified to provide additional small group laboratory exercises.

Laboratory instructions are provided for a number of exercises that may be done by the students. For most of the exercises two or three students per team would probably be appropriate although this may vary for a particular exercise. As the number of students per team increases above three, the value to the individual student in being able to observe and develop techniques decreases significantly.

The science problem students will have had little previous opportunity for actual laboratory experiences and will need careful preparation and supervision especially during the early part of the year. He should be expected to follow directions carefully and proceed in a businesslike manner. He should be instructed not to attempt any experimentation that is not specified in the instructions or specifically approved by the instructor.

Much of the value of any laboratory experience is derived from the preliminary and follow-up discussions of the exercise. Some of the students will miss the point of the experiment entirely unless guidance is given, and new questions will often arise that need exploration.

The teacher information which accompanies each exercise was designed to facilitate preparation. It also draws attention to some aspects of the exercise that may be of particular concern, as well as some supplementary information to the teacher who may be teaching a unit out of his field. An attempt was made to indicate which department of the school may have certain in-school materials available.

Safety

It is extremely important to stress safety in the performance of laboratory demonstrations and experiments. Teachers should familiarize themselves with the San Diego City Schools publication Handbook of Science Laboratory Practices and Safety (Stock No. 41-L-0500) before engaging in any laboratory activity. Careful consideration should be given in planning each laboratory experience to determine the optimum amount and kind of student training in laboratory procedure that should be given.

Student Evaluation

The authors of the basic text have prepared unit tests as well as midyear and final tests to assist in student evaluation. Copies of these tests are provided each school to serve the teacher as guidelines in preparing his evaluative devices. The teacher should bear in mind the value of carefully prepared tests and quizzes as teaching devices. Student evaluation should naturally include all phases of classwork and homework, as well.

SUPPLIES AND EQUIPMENT

Advanced planning is necessary to make certain that all of the supplies and equipment will be on hand when needed. For example, the determination of delivery dates for live material and ordering same should be accomplished very early in the year. Most of the materials required for the experiments are available within the school, and an attempt has been made to indicate where they may be found. Cafeteria, homemaking department, art department, shops and the custodian are sources for many of the unusual materials that may be required from time to time. Students may volunteer to bring supplementary materials from home.

If it is necessary to purchase additional supplies there are three possible ways to do so; each requires the approval of the department chairman and school principal.

1. Stock items*- A number of frequently called-for nonperishable items are kept in stock and if ordered may usually be acquired within two weeks. Do not limit yourself to the science stock (Class 29) as stock items listed for the shops, homemaking, art, etc. may be needed.

2. Nonstock items*- As much as a month should be allowed for delivery of nonstock items - again you may wish to inspect the total nonstock catalogue rather than confining yourself to the science sections.

3. Direct purchase - Provisions are made for the direct purchase of certain necessary items which may be of a perishable or emergency nature. The San Diego Unified School District Administrative Regulation and Procedures No. 7275 governs this action and should be read carefully noting especially; (a) the procedures to follow, (b) the restrictions as to cost, and (c) unauthorized items.

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*Complete stock and nonstock catalogs may be available from the department chairman, the library or the general secretary.

Unit One

THE NATURE OF SCIENCE

1-2 WEEKS

A SCIENTIFIC APPROACH

Chapter 1*

LEARNING OBJECTIVES:

To become familiar with the ways of science and scientists.

To understand the process of measurement.

To learn to use the metric system.

To become aware of the limits of accuracy in measurement.

TEXT REFERENCES:

Herron and Palmer, pages 3-23

Herron and Palmer, Teacher's Guide, pages 11-16

Brooks, et al, pages 2-9

RESOURCE MATERIALS:

Joseph, et. al., Teaching High School Science: A Sourcebook for the Physical Sciences, Harcourt, Brace and World, Inc., 1961.

Morholt, et. al., Teaching High School Science: A Sourcebook for the Biological Sciences, Harcourt, Brace and Company, 1958.

AUDIO-VISUAL MATERIALS:

Films, Part I:

Using the Scientific Method	11 min.	b & w	S - J
Science and Agriculture (The Soybean)	11 min.	b & w	S - J
Scientific Method	11 min.	b & w	J - S
Golden Glory	30 min.	b & w	1 - A
Scientific Method in Action	19 min.	color	J - S
Pasteur's Legacy	23 min.	b & w	S
How To Concentrate	10 min.	b & w	S - J
How To Observe	10 min.	b & w	S - J
Science Fair	14 min.	color	J thru A
Louis Pasteur, Man of Science	25 min.	b & w	J - S
Key To The Future	30 min.	color	1 thru A

*Chapters refer to those in the basic text entitled Matter, Life and Energy, by Herron and Palmer, 1965.

Part II:

Assignment - Weights and Measures	18 min.	color	I thru A
Measuring Techniques	14 min.	color	S thru A
Weighing Techniques	8 min.	color	S thru A

Filmstrips:

Fs 500	New Conquests of Nature	S - C
Fs 500	Science Opens New Doors	J thru A
Fs 500	Science, Technology and Society	S - J
Fs 507.2	Scientist: His Way, Your Way	J
Fs 614.85	Protecting Eyes at Work	J or S
Fs 542	Laboratory Techniques	S

INSCHOOL MATERIALS:

Metric System Chart, Physics, Chem

Balances, Double Beam, Bio, Chem, Physics

Balances, Triple Beam, Bio, Chem, Physics

Caliper, Micrometer, Physics

Stick, Meter (Stock 29-S-7750) Physics, Chem

Ruler, Plastic (Nonstock RUL-0050) Bio, Chem, Physics

CLASSROOM ACTIVITIES:

Recommended Laboratory Exercises:

1. Orientation to the Laboratory - See Appendix page 243.

2. Measurement and Observation - See Appendix page 247.

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 12-14 for discussion directed at the content of chapter 1 of the text.

2. What are the personality characteristics which a scientist should possess?

3. Why are scientists careful to read the current scientific publications, as well as to refer constantly to reports on research done in the past? Why do they attend conventions?

4. A great deal of the scientific research seems to be centered around certain locations such as colleges and universities, hospitals, government sponsored agencies and certain private industries. What are some reasons for this? Is there a different kind of motivation in each case?

5. Why are scientific discoveries and application occurring much more rapidly today than fifty years ago?

6. Are scientists responsible for the improper use sometimes made of their discoveries?

7. Compare a scientific hypothesis, theory, principle and law.

8. What is meant by a controlled experiment?

9. Why is it important to repeat experiments several times and collect as much data as possible?

10. Why do scientists use the metric rather than the British system of measurement?

Activities Suggestions:

1. Use the map of the Greater San Diego Area (page 213) to make a transparency for use in pointing out where centers of scientific research are located in this area. Be sure to include:

   (a) Key educational institutions
         University of California, San Diego
         San Diego State College
         Scripps Institution of Oceanography

(b) Hospitals
    Navy Hospital
    County Hospital (Operated by UCSD)

(c) Government Agencies
    Navy Electronics Laboratory

(d) Private Industry
    Salk Institute for Biological Studies
    General Atomic
    Astronautics
    Convair
    Rohr Aircraft
    Ryan Aeronautical
    Solar
    Lockheed Research

2. Make a transparency of the map of the United States (page 216) to point out a few centers of scientific research--e.g. UC-Berkeley, Walter Reed Army Hospital, Mayo Clinic, NASA Headquarters, Houston, etc.

3. Have students clip ads and articles from current periodicals illustrating the part played by science in improving health, communication, and transportation; in reducing work, and in providing new materials.

4. Interview a professionally trained person such as a scientist, engineer or medical specialist to learn what relationship his work has to the various sciences.

5. Find out some of the training requirements for careers in the various sciences, engineering and technology.

6. Have students write a short paper on the subject, "How is my parent's occupation influenced by science?"

7. Have the class practice measuring the length of common objects with a metric system ruler. Use selected problems from the metric system practice sheets. See Appendix page 224.

Teachers' Evaluation of
of
Course Guide

UNIT NO. 1 *

1. List the title of any visual aids which you feel are inadequate or misplaced. (Specify)

2. List any titles which should be added to the audio-visual list.

3. List any demonstrations and/or laboratory exercises which proved unsatisfactory. Please explain.

4. What additional demonstrations and laboratory exercises should be added to this unit? Please describe or submit draft.

EVALUATION SHEET

5. Which worksheet should be deleted or changed?

6. What additional worksheets should be added to this unit? Please describe or submit draft.

7. Other suggestions.

*Please fill out this form on the completion of each unit. Completed forms should be sent to the Science Specialist, Room 2041, Education Center at the end of each semester during the school year 1966-67.

Unit Two

MATTER AND ENERGY

2 - 3 WEEKS

THE STRUCTURE OF MATTER

Chapter 2

LEARNING OBJECTIVES:

To become familiar with the development of the various models of the atom.

To learn the quantitative basis of atomic structure (atomic number, atomic weight).

To understand the different types of chemical bonding.

To recognize the different properties of matter.

TEXT REFERENCES:

Herron and Palmer, pages 25-42

Herron and Palmer, Teacher's Guide, pages 17-20

Brooks, et. al., pages 9-16, 19-31

RESOURCE MATERIALS:

Joseph, et. al., Teaching High School Science: A Sourcebook for the Physical Sciences, Harcourt, Brace and World, Inc., 1961.

AUDIO-VISUAL MATERIALS:

Films, Part I:

Evidence for Molecules and Atoms	19 min.	color	I or J
Explaining Matter: Atom and Molecules	14 min.	b & w	I - J
Structure of Atoms	13 min.	color	J - S
Atomic Theory	9 min.	b & w	S - C
Bohr Atom	30 min.	b & w	S thru A
Electron Shell Structure	30 min.	b & w	S thru A

Part II:

World of Molecules	11 min.	color	I - J
Explaining Matter: Molecules in Motion	11 min.	color	J thru A
Determining Molecular Formulas	13 min.	color	J - S
Solids, Liquids and Gases	10 min.	b & w	I - J

Filmstrips:

Fs 539	Man Discovers the Atom	
Fs 539.1	Molecular Forces in Matter	S
Fs 539.1	Structure of Matter	S
Fs 539.14	Composition of Atoms	S - J
Fs 540	Introduction to Chemistry	I - J
Fs 540	What is Chemistry?	S - J
Fs 541	Chemical Bond	S
Fs 541.24	Atom. Copy B	J
Fs 539.1	Classification of Matter	S - J
Fs 539.1	World's Matter Supply	J
Fs 541	Atomic and Molecular Models	S
Fs 530.1	All Matter Has Three Forms	I or J

Transparencies:

Trns	Atomic Series	I thru A

INSCHOOL MATERIALS:

Periodic Chart of the Elements, Bio, Chem, or Physics

Molecular Model Set (Nonstock MOL-9080) Physics, Chem

Atom Model Kit, Fisher-Hirschfelder-Taylor, Chem

Brownian Movement Apparatus, (Nonstock BRO-9000) Chem or Physics

Molecular Motion Demonstration Tube (Nonstock MOL-9085) Chem or Physics

CLASSROOM ACTIVITIES:

Recommended Laboratory Exercises: Changes in Matter: Physical and Chemical Changes. See Appendix page 253.

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 17-19.

2. What are molecules? What is true of the position of the molecules

in a solid? In a liquid? In a gas? Are there spaces between molecules? Are molecules always moving? What do molecules contain?

3. Discuss the addition or removal of heat as a means of changing matter from one state to another-solid to liquid, liquid to solid, etc.

4. Discuss Periodic Chart and its use to scientists.

5. Why are scientists interested in learning more about the structure of atoms and molecules?

Activities Suggestions:

1. Demonstrate molecular structure using the molecular model set (Nonstock MOL-9080) from chemistry.

2. Demonstrate molecular motion by setting up the Brownian movement apparatus (Nonstock BRO-9000) from chemistry or physics. You will need a bright light source and a microscope to observe the movement. Discuss the evidence for molecular motion gained by this apparatus.

3. Demonstrate molecular motion using the molecular motion demonstration tube (Nonstock MOL-9085) from chemistry or physics which consists of a glass tube containing mercury and glass particles. Heating the mercury vaporizes it whereby the glass particles are made to bounce about, seemingly without provocation.

4. It is fairly easy to see that solids and liquids have the properties that we attribute to matter in its definition, that they have weight and take up space. It is, however, more difficult for a student to recognize that a gas has these properties. You can show that air has weight by weighing a football before and after it is inflated. This will also show that air takes up space, but it can be demonstrated more simply by pushing a glass or bottle (empty except for air) open-end down into a container of water and show that the water does not enter because air is already present and must be removed before water will enter.

ENERGY AND CHANGING MATTER

Chapter 3

LEARNING OBJECTIVES:

To gain an understanding of the concept of energy.

To learn to recognize the difference between chemical and physical changes.

To become aware of the conservation laws of matter and energy.

To learn to use chemical symbols in writing chemical reactions.

TEXT REFERENCES:

Herron and Palmer, pages 43-53.

Herron and Palmer, Teacher's Guide

Brooks, et. al., pages 16-17, 45-66, 229-232.

RESOURCE MATERIALS:

Joseph, et. al., Teaching High School Science: A Sourcebook for the Physical Sciences, Harcourt, Brace and World, Inc. 1961.

AUDIO-VISUAL MATERIALS:

Films, Part I:

Energy	12 min.	b & w	J - S
Energy and Its Transformation	12 min.	b & w	S

Part II:

Energy and Reaction	15 min.	color	J - S
Energy and Its Forms	11 min.	color	I
Matter and Energy	10 min.	b & w	S

Part III:

Chemical Changes All About Us	14 min.	color	I - J
Faraday's Laws	16 min.	color	J - S
Electromotive Force Series	12 min.	color	J - S
Oxygen	10 min	b & w	S - J
Family of Halogens	13 min.	color	J - S
Chemistry and a Changing World. 2nd Ed.	11 min.	b & w	J or S

Filmstrips:

Fs 541.2	Molecules, Atoms and Simple Reactions	S - J
Fs 541.2	Simplest Formula of a Compound	S - J
Fs 541.37	Putting Electrolysis to Work	J or S

Transparencies:

Trns	Atomic Series	I thru A

INSCHOOL MATERIALS:

Periodic Chart of the Elements, Bio, Chem or Physics

Electrolysis Apparatus, Chemistry

Molecular Model Set (Nonstock MOL-9080), Physics, Chem

CLASSROOM ACTIVITIES:

Recommended Laboratory Exercises: Elements, Compounds and Mixtures, see Appendix page 257.

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 21-23.

2. Discuss corrosion as an undesirable chemical reaction and means of controlling it. For example, protection of ships, houses, bridges.

3. Discuss use of catalysts to speed up or slow down reactions.

4. Discuss changes in temperature and concentration of reactants on reaction rates.

5. Discuss dangers of acids and bases to body, external and internal. See Handbook of Science Laboratory Practices and Safety for first aid practices, etc.

6. Have students suggest which of the substances in the chart (upper right page 52 of text) might be used to "sweeten a sour (acid) stomach."

7. Is San Diego a city noted for its chemical industry? Discuss ideal characteristics of a city which would appeal to chemical industries.
   --e.g. Large amounts of cheap (and non-corrosive) water.
   Raw materials readily available.
   Good transportation facilities.
   Central location for marketing products.
   Labor supply.

Activities Suggestions:

1. Demonstrate the chemical decomposition of water using the electrolysis apparatus (Nonstock ELE-2000) from chemistry. See Joseph, et. al., Sourcebook for the Physical Sciences.

2. Demonstrate use of common indicators such as phenolphthalein, litmus paper and Hydrion paper in determining acidity and basicity.

3. Preparation of acids: Place a small amount of sulfur in a deflagrating spoon and ignite it with a Bunsen burner. Lower the spoon with the sulfur into a wide-mouthed bottle that has a little water in the bottom. After a half minute or so, remove the sulfur, cover the bottle and shake. Drop a piece of blue litmus paper into the solution. Drop a red flower into the jar and leave for a few minutes. Sulfurous acid is a good bleaching agent. Carbon (charcoal) or a very small amount of red phosphorus can be substituted for the sulfur.

4. Preparation of a base: Add a small piece of CaO to some water in a beaker. Stir the mixture and test it with red litmus paper.

Teachers' Evaluation of
of
Course Guide

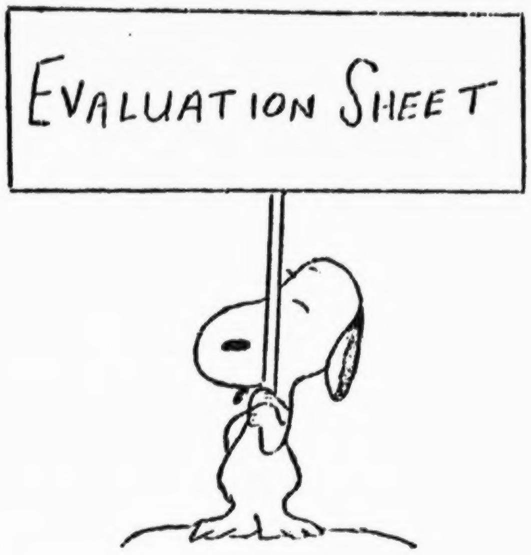
UNIT NO. 2 *

1. List the title of any visual aids which you feel are inadequate or misplaced. (Specify)

2. List any titles which should be added to the audio-visual list.

3. List any demonstrations and/or laboratory exercises which proved unsatisfactory. Please explain.

4. What additional demonstrations and laboratory exercises should be added to this unit? Please describe or submit draft.



5. Which worksheet should be deleted or changed?

6. What additional worksheets should be added to this unit? Please describe or submit draft.

7. Other suggestions.

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Unit Three

THE ATMOSPHERE

2 - 3 WEEKS

WE LIVE IN AN OCEAN OF AIR

Chapter 4

LEARNING OBJECTIVES:

To become familiar with the physical and chemical composition of the atmosphere.

To understand the effects of air pressure.

TEXT REFERENCES:

Herron and Palmer, pages 57-70.

Herron and Palmer, Teacher's Guide, pages 25-28.

Brooks, et. al., pages 486-492.

RESOURCE MATERIALS:

American Geological Institute, Geology and Earth Sciences Sourcebook for Elementary & Secondary Schools, Holt, Rinehart and Winston, Inc., 1962.

Joseph, et. al., Teaching High School Science: A Sourcebook for the Physical Sciences, Harcourt, Brace and World, Inc., 1961.

AUDIO-VISUAL MATERIALS:

Films, Part I:

Air All About Us	11 min.	color	I - J
Engineering Your Health	14 min.	color	S thru A

Part II:

Air in Motion	13 min.	b & w	I
Air Pressure	11 min.	b & w	I thru A
Air All Around Us	10 min.	b & w	I - J

Filmstrips:

Fs 533	Our Ocean of Air	J - I
Fs 533	Air Works for Man	J - I
Fs 545.7	Composition of Air	J - I
Fs 551.51	Earth's Atmosphere	J - I
Fs 551.5	Canopy of Air	J or S

Fs 551.51	Atmosphere	S or C
Fs 551.51	Physical Characteristics of Air	J - I
Fs 551.54	What is Air Pressure	J - I

Transparencies:

Trns 551.5	Meteorology	color	I thru A

INSCHOOL MATERIALS:

Aneroid Barometer, Physics

Magdeburg Hemispheres, Physics

Pump, Vacuum Pressure, Physics

Bell Jar, Chem or Physics

CLASSROOM ACTIVITIES:

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 26-27.
2. Discuss air pollution and its related causes, air contamination by industry and automobiles, terrain, prevailing winds.
3. Discuss such properties of air as pressure, moisture holding and distribution, protection from cosmic rays, movements, various layers, ways in which air serves us, and so forth.
4. Discuss the process of liquefaction of air and the uses made of the liquid air and its components.

Activities Suggestions:

1. Show how the atmosphere can crush a can as shown in "Try This," page 65 of text. Cans may be obtained from the custodian or empty duplicating fluid cans may be used.
2. Make a mercurial barometer and measure the atmosphere pressure. (See "Try This," page 68, text.) Many of the air bubbles may be eliminated alongside the tube by introducing the mercury slowly and intermittently running a medium fine copper wire up and down along the tube. Use an extra high form bell jar (from physics) and the vacuum pump (from physics) to demonstrate what happens when the atmospheric pressure is reduced.

3. Set up a model siphon to demonstrate that its operation is dependent upon air pressure.

4. Demonstrate slow oxidation by placing a moistened wad of steel wool in a flask. Place a length of glass tubing in a one-hole rubber stopper and insert tightly into the flask. Invert the flask on a ring stand so that the tube extends into a beaker of colored water. Note the rise of water as oxidation occurs.

OUR WEATHER

Chapter 5

LEARNING OBJECTIVES:

To become aware of the origin of winds.

To learn to distinguish between different types of windstorms.

To gain facility in determining the amount of moisture in the air.

To learn to associate different cloud types with different weather conditions.

To see how air masses and fronts affect weather.

To learn how to read weather maps and forecast weather changes.

TEXT REFERENCES:

Herron and Palmer, pages 71-93.

Herron and Palmer, Teacher's Guide, pages 29-35.

Brooks, et. al., pages 483-486, 492-519.

RESOURCE MATERIALS:

Selected publications on General Weather Science Study. See Appendix page 221.

American Geological Institute, Geology and Earth Sciences Sourcebook for Elementary & Secondary Schools, Holt, Rinehart and Winston, Inc., 1962.

Joseph, et. al., Teaching High School Science: A Sourcebook for the Physical Sciences, Harcourt, Brace and World, Inc., 1961.

AUDIO-VISUAL MATERIALS:

Films, Part I:

Inconstant Air	29 min.	color	S thru A
Atmosphere and Its Circulation	11 min.	b & w	I
Great Winds--Distribution of Pressure and Winds	10 min.	b & w	J - I
Great Winds--General Circulation	10 min.	b & w	J - I
Wind at Work	11 min.	color	I - J

Part II:

Water Cycle	10 min.	b & w	I - J
Treasures in Snow	6 min.	color	I thru A
Its the Humidity	13 min.	color	S - C
Clouds Above	10 min.	color	I - J

Part III:

What Makes a Desert	10 min.	b & w	I - J
Weather	11 min.	b & w	J - S
Life in Mediterranean Lands (Calif.)	10 min.	color	I - J

See film catalog for additional films.

Part IV:

Reading Weather Maps	14 min.	color	I or J
Thunderstorms	41 min.	b & w	J thru A
Weather, Breath of Life	28 min.	color	I thru A
How Weather is Forecast	10 min		I - J
Eyes in Outer Space	26 min.	color	J - S
Unchained Goddess, Part I	30 min.	color	I thru A
Unchained Goddess, Part II	30 min.	color	I thru A
Origin of Weather	13 min.	color	I - J
Research by Rockets	29 min.	color	S thru A

See film catalog for additional listings.

Filmstrips:

Fs 551.5	Air and Weather	J
Fs 551.5	Weather and the Jet Stream	J
Fs 551.51	Atmosphere and Its Circulation	J or S
Fs 551.51	Maelstroms of the Air	J
Fs 551.57	Mystery of Rain	J

Fs 551.59	Climate		I or J
Fs 551.591	What Makes the Weather		I - J
Fs 551.59	Changing Weather, Parts A and B		J
Fs 551.591	Weather, Copy E		J
Fs 551.45	Desert		J or S
Fs 551.55	Tornadoes: What They Are and What to Do About Them		

Slides:

2x2	Art in Nature: Clouds and Sky		I thru A
2x2	Story of the Clouds		I thru A

Study Prints:

SP-M 551.45	Deserts of the World		I thru A
SP-S 551.5	Weather		I thru A
SP-M 551.54	Ground Water		I thru A
SP-S 551.57	Cloud Code Chart		I thru A
SP-S 551.57	Cloud Forms		I thru A
SP-M 551.572	Familiar Cloud Forms	color	all gr.
SP-S 551.573	Snow, the Servant of Man		all gr.
SP-O 551.59	Weather and Climate	color	all gr.
SP-M 551.591	Weather Instruments		

Transparencies:

Trns 551.5	Meteorology	color	I thru A
Trns 551.59	Climates		I or J

INSCHOOL MATERIALS:

Map, Polar, Aeronautical World, **Physics**

Map, World, Summer Rainfall, **Physics**

Map, World, Thermal Regions, **Physics**

Maximum-Minimum Thermometer, Physics

Sling Psychometer, (Nonstock HYG-6050) Physics

Aneroid Barometer, Physics or Chemistry

Hygrometer, (Nonstock HYG-6000) Physics

CLASSROOM ACTIVITIES:

Recommended Laboratory Exercises: A Study in Climate. See Appendix page 263.

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 29-32.
2. Discuss reasons why temperatures are normally lower at higher altitudes.
3. What are some of the important uses of weather forecasting?
4. Discuss how a warm front and cold front are formed. Compare them in regard to size, type of weather, cloud types, types of air present.
5. Relate the kinds of storm centers formed by fronts. Show how these affect San Diego.
6. Relate the equalization of temperatures, due to large bodies of water, to California and San Diego.

Activities Suggestions:

1. A daily weather chart prepared from student observation showing barometric pressure, temperature, and relative humidity of the outside air, cloud forms, wind directions and speeds, should be kept by the students. See worksheet prepared for keeping the data, Appendix page 228.
2. Reproduce copies of Weather Data For the Year 1965 (see Appendix page 218). Assign certain students or groups to make a graph so that specific monthly information for each of the six San Diego County locations is included on one graph. For example, one group will graph the mean high, another the mean low, etc. Compare the graphs and evaluate them individually, discussing reasons for the variations from one location to another. A transparency of San Diego County Map (see Appendix page 214).
3. Determine the dew point (See "Try This," page 83 of the text) on a particular day or series of days. Compare it to the relative humidity readings and discuss its significance.

4. The San Diego Union and Tribune publishes a weather map each day. A smaller map shows the expected weather over the U.S. on that day. Students should be encouraged to bring in these maps and to learn to interpret them.

5. Display several copies of weather maps and discuss symbols.

6. Have students report on some of the latest attempts to find ways to control the weather.

7. Have the students compare different kinds of storms in regard to geographical size, location, intensity, etc.

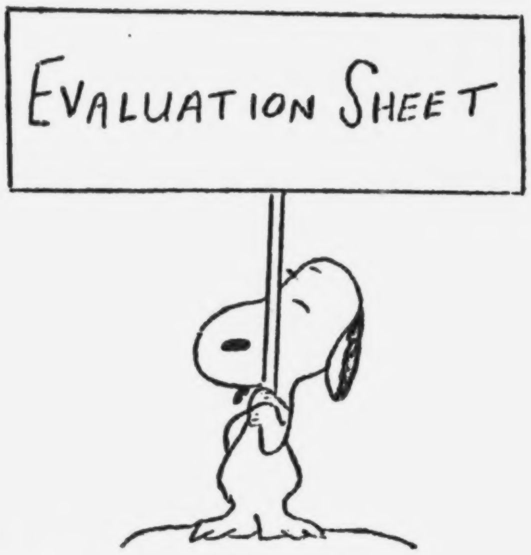
8. Evaporation - As a cooling process. Fasten a piece of absorbent cotton around the base of a thermometer and saturate with alcohol. Determine the effect of circulation on evaporation rate and cooling.

9. Suggested Student Reports:

    Weather satellites
    Rain making
    Fog dispersal
    Long-range weather forecasting
    Weather control for crop protection

Teachers' Evaluation of
of
Course Guide

UNIT NO. 3 *



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Unit Four

THE HYDROSPHERE

3 - 4 WEEKS

OUR WATER SUPPLY

Chapter 6

LEARNING OBJECTIVES:

To learn some of the basic physical and chemical facts about fluids.

To become able to apply Archimedes' principle.

To develop a knowledge of how our civilization obtains and uses water.

TEXT REFERENCES:

Herron and Palmer, pages 95-112.

Herron and Palmer, Teacher's Guide, pages 35-40.

Brooks, et. al., pages 70-82.

RESOURCE MATERIALS:

Pamphlets (1) The San Diego Water Supply and (2) Alvarado Filtration Plant are available from the Utilities Department, City of San Diego. Class sets are available.

Joseph, et.al., Teaching High School Science: A Sourcebook for the Physical Sciences, Harcourt, Brace and World, Inc., 1961.

American Geological Institute, Geology and Earth Sciences Sourcebook for Elementary & Secondary Schools, Holt, Rinehart and Winston, Inc., 1962.

AUDIO-VISUAL MATERIALS:

Films, Part I:

Liquids in Solution	11 min.	color	J - S
Dynamics of Solution	15 min.	color	J - S
Structure of Water	14 min.	color	J - S
Mysteries of Water	11 min.	b & w	J - I

See film catalog for additional films.

Part II:

Mechanics of Liquids	11 min.	color	S - C
Simple Demonstrations With Water	14 min.	b & w	I - J
Archimedes' Principle	6 min.	b & w	S - J

Part III:

Dams	14 min.	color	I thru A
Water, Lifeblood of the West	13 min.	color	I thru A
Man's Problem	19 min.	color	S - J
Water Supply	11 min.	color	J or S

See film catalog for additional films.

Part IV:

Environmental Sanitation	10 min.	color	I thru A
Clean Waters	23 min.	color	J thru A
Water, Friend or Enemy	10 min.	color	J or S
Power By Which We Live	20 min.	color	J - S
How We Get Our Power	11 min.	b & w	I - J

Filmstrips:

Fs 333.91	Enough Water For Everyone	I - J
Fs 532	Floating and Moving on Water	I thru A
Fs 551.48	Story of Rivers	I or J
Fs 551.48	Story of Underground Water	I or J
Fs 620.2	Putting Water to Work	S
Fs 628.1	Water Supply	I thru A

See audio-visual catalog for additional listings.

Soundstrip:

Ss 591.92	Science of the Sea (Rec, 8 Fs, Col, 3 Manuals)	I thru A

Study Prints:

SP-S 627.8	San Diego County Dams, Set A	I thru A
SP-S 627.8	San Diego County Dams, Set C	I thru A
SP-S 628.167	Saline Water Conversion	I thru A

INSCHOOL MATERIALS:

Seawater Conversion Plant (Sound Filmstrip)

Baroscope, Bell Jar, and Vacuum Pump, Physics

Electrolysis Apparatus, Chem

Condensor, Leibig Type, (Nonstock CON-0050), Chem or Physics

Specific Gravity Bottle, (Nonstock SPE-1000), Chem or Physics

Archimedes' Principle Apparatus, (Nonstock ARC-1000), Chem or Physics

Capillary Apparatus, (Nonstock CAP-2000), Chem, Physics, Bio

Cartesian Diver, (Nonstock CAR-2996), Chem, Physics

Overflow Can, (Nonstock OVE-3800), Physics

Catch Buckets, (Nonstock CAT-1000), Chem, Physics

Constant Level Tubes, (Nonstock CON-0350), Chem, Physics

Hydrometer, (Nonstock HYD-4000), Chem, Physics

Surface Tension Apparatus, (Nonstock SUR-0800), Physics

CLASSROOM ACTIVITIES:

Suggested Laboratory Exercise: Water, see Appendix page 264.

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 36-38.

2. Discuss San Diego's water supply problem, including such factors as: climate, population growth, watershed, hardness of water, aquaducts.

3. Discuss the term "water table." Relate the recent drought years of California to the lowering of the table.

4. Discuss the fact that three-fourths of the earth's surface is covered with water.

5. Discuss and demonstrate various methods of water purification, e.g., settling, filtration, aeration, precipitation, chlorination, and distillation. Have a student find out if all of these methods are used in San Diego, and report to the class.

6. Discuss what kinds of substances remain in the water after treatment. Is it chemically pure or potable?

7. What is the difference between "pure" water and chemically pure water?

8. What are some uses of chemically pure water?

9. Of what importance is the phenomenon that water expands when it freezes?

10. What effects do air pressure and dissolved substances have upon the boiling point of water?

11. Why is well water not always safe to drink?

12. How should water from natural sources be treated when you are out hiking or camping?

13. Discuss the potential energy of a body of water at rest and how it is transformed into kinetic energy which drives the turbine of a generator to produce electricity.

14. Why is water used as the basis for determining "specific gravity?"

15. Discuss "lighter-than-air" craft as an application of Archimedes' Principle.

Activities Suggestions:

Obtain class sets of the publications, The San Diego Water Supply and Alvarado Filtration Plan from the Utilities Department, City of San Diego for up-to-date local information.

1. Flocculation: To a 1 liter cylinder of muddy water stir in 25 ml of aqueous $AlCl_3$, then add 25 ml conc. NH_4OH and stir. Observe how the $Al(OH)_3$ settles, taking the mud with it.

2. Have a student demonstrate and explain a solute, a solvent, a solution, a saturated solution, a concentrated solution, and a dilute solution using salt, sugar, or copper sulphate, and water.

3. Demonstrate the production of chemically pure water by distillation. Is this water good for continued use as a drinking water?

4. Reports on the construction and use of a submarine or bathysphere will give added emphasis to the importance of water pressure.

5. Have a student report on fluoridation of drinking water.

6. Demonstrate one or more of the following:

   a. Cartesian diver, (Nonstock CAR-2996) from physics.

   b. Capillary action as on page 97 in text using capillary apparatus, (Nonstock CAP-2000) from physics.

   c. Water seeking constant level as on page 97 in text using constant level tubes, (Nonstock CON-0350) from physics.

   d. Purification of water by distillation as on page 107 of text using Leibig condenser, (Nonstock CON-0050) from chemistry.

   e. Archimedes' Principle as on page 218 of Brooks using catch bucket, (Nonstock CAT-1000) and overflow can, (Nonstock OVE-3800) both from physics.

   f. Archimedes' Principle as in A Sourcebook for the Physical Sciences, page 349 using the Archimedes' Principle apparatus, (Nonstock ARC-1000) from physics.

   g. Archimedes' Principle as it applies to the buoyant effect of air, using the baroscope, using the large bell jar and vacuum pump.

EXPLORING THE OCEAN

Chapter 7

LEARNING OBJECTIVES:

To understand some of the methods used by scientists in studying the hydrosphere.

To become familiar with the salient features of the ocean floor.

To develop a knowledge of the mechanisms of ocean waves and currents.

To learn how tides are produced.

To see how man may use the oceans.

TEXT REFERENCES:

Herron and Palmer, pages 113-131.

Herron and Palmer, Teacher's Guide, pages 40-45.

Brooks, et. al., pages 520-536.

RESOURCE MATERIALS:

American Geological Institute, Geology and Earth Sciences Sourcebook for Elementary & Secondary Schools, Holt, Rinehart and Winston, Inc. 1962.

Joseph, et. al., Teaching High School Science: A Sourcebook for the Physical Sciences, Harcourt, Brace and World, Inc., 1961.

AUDIO-VISUAL MATERIALS:

Films, Part I:

Oceanography: Science of the Sea	11 min.	color	I or J
What's Under the Ocean	14 min.	color	I - J
Diving Saucers	30 min.	color	J thru A
Life in the Sea	11 min.	color	I thru A
Sounds in the Sea	16 min.	color	I - J
Australia's Coral Wonderland	30 min.	color	I thru A

See film catalog for additional films.

Part II:

Ocean Currents	17 min.	color	J
Challenge of the Oceans	29 min.	color	S thru A
Restless Sea, Part I	30 min.	color	I thru A
Restless Sea, Part II	30 min.	color	I thru A

Part III:

Tides of the Ocean	16 min.	color	J - I
Ocean Tides: Bay of Fundy	14 min.	color	I thru A

Part IV:

Marine Biologist	14 min.	color	J - S
Shell-Fishing	11 min.	b & w	I thru A
Tuna Story	26 min.	color	I thru A
Tuna Packing	10 min.	color	I thru A
Tuna: From Catch to Can	27 min.	color	I thru A
Harvest of the Sea	20 min.	color	I thru A
Drugs and Poisons from the Sea	30 min.	color	J thru A
Science of the Sea	19 min.	color	I thru A

Filmstrips:

Fs 333.91	Wealth in the Ocean	I thru A
Fs 551	Miracle of the Sea	J or S
Fs 551.46	Mighty Currents of the Sea	J
Fs 551.46	Landscapes of the Sea	J

Slides:

664.2	2x2	Salt From the Sea	I thru A

Study Prints:

SP-M 551.46	The Sea

SP-S 627.8 San Diego County Dams, Set A I thru A

SP-S 627.8 San Diego County

INSCHOOL MATERIALS:

CER Oceanography Kit (Sound Filmstrip)

Condensor, Leibig Type, (Nonstock CON-0050), Chem or Physics

Sealab II (Sound Filmstrip)

Specific Gravity Bottle, (Nonstock SPE-1000), Chem or Physics

CLASSROOM ACTIVITIES:

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 41-43.
2. Discuss San Diego's part in oceanographic research. Use a transparency of the greater San Diego area to indicate the location of Scripps Institution of Oceanography and encourage students to visit the aquarium, etc.
3. Discuss the ocean as a source of food for mankind.
4. Discuss the food chains in the ocean.
5. Discuss why ocean is more salty now than it was previously.
6. Discuss the characteristics of salt lakes and their formation.
7. Discuss buoyancy of sea water.
8. Discuss the problem of taking on board a fish from a great depth in the ocean.
9. Discuss why ocean water is slow to freeze.
10. Discuss the effect of the earth's rotation on movements of the currents in the oceans--the Coriolis Effect.
11. Discuss the formation of and dangers of riptides.

Activities Suggestions:

1. Have students gather information on how to capture the kinetic energy of the waves in the ocean.
2. Have students find the information needed to compare the tides of the Atlantic and Pacific oceans.

3. Set up a salt water aquarium with common tidepool life.

4. Have students gather information on:

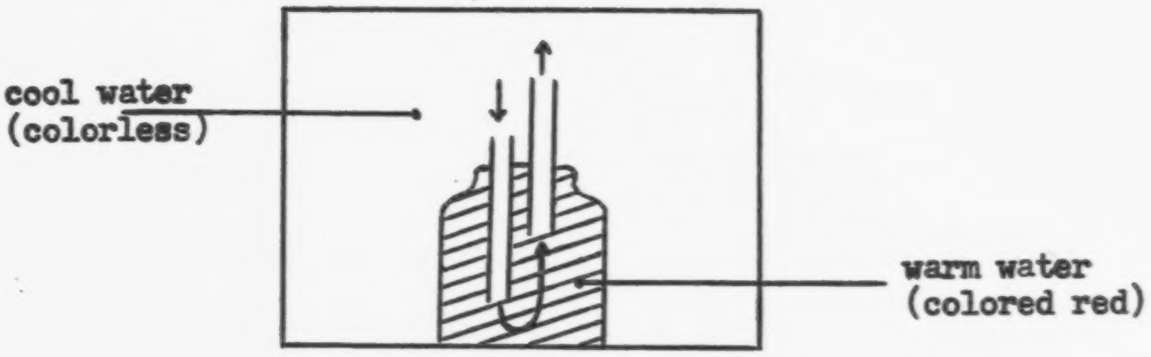
   a. Recovery and use of minerals from the ocean.

   b. Use of animals from the ocean.

   c. Use of plants from the ocean.

5. Display collections of sea shells and discuss the problems of survival encountered by their former tenants.

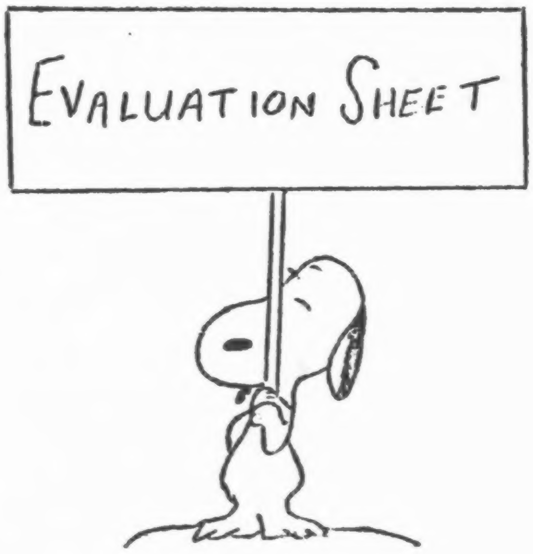
6. To further explain the ocean current set up a convection current apparatus as below, using an aquarium or battery jar, a bottle, two holed stopper and glass tubing. Have students observe that warm colored water rises while cold water sinks. Similarly, equatorial water is warm, rises, and is pushed by the wind toward the poles forming surface currents. Cold water sinks and moves from the poles toward the equator to take the place of the displaced warm water, causing deep currents called density currents.



7. Have students report on: thermal layers in the ocean, tsunamis, Sargasso sea, upswelling, reasons for sudden changes in ocean temperature, rip tides, skin diving.

Teachers' Evaluation of
of
Course Guide

UNIT NO. 4 *



1. List the title of any visual aids which you feel are inadequate or misplaced. (Specify)

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2. List any titles which should be added to the audio-visual list.

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7. Other suggestions.

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Unit Five

THE LITHOSPHERE

2-3 WEEKS
(OPTIONAL)

THIS CHANGING EARTH

Chapter 8

LEARNING OBJECTIVES:

To understand how scientists use seismic methods to investigate the earth.

To learn the main surface features of the lithosphere.

To develop a knowledge of how building-up and tearing-down forces affect the surface of the lithosphere.

TEXT REFERENCES:

Herron and Palmer, pages 133-151.

Herron and Palmer, Teacher's Guide, pages 45-50.

Brooks, et. al., pages 450-455, 461-482.

RESOURCE MATERIALS:

Hertlein, L. G. and U. S. Grant, IV, The Geology and Paleontology of the Marine Pliocene of San Diego, California, Volume II, Part I, Geology, San Diego, California, printed for the San Diego Society of Natural History, 1944.

American Geological Institute, Geology and Earth Sciences Sourcebook for Elementary & Secondary Schools, Holt, Rinehart and Winston, Inc. 1962.

Joseph, et. al., Teaching High School Science: A Sourcebook for the Physical Sciences, Harcourt, Brace and World, Inc., 1961.

AUDIO-VISUAL MATERIALS:

Films, Part I:

Hidden Earth	29 min.	color	S thru A
What's Inside the Earth	13 min.	color	I or S
Interior of the Earth	14 min.	color	S - J

Part II:

Time Changes the Land	23 min.	color	I thru A
River of Ice: Life Cycle of a Glacier, 2nd ed.	10 min.	color	I thru A
Monument Valley	22 min.	color	I thru A
In the Beginning: The Grand Canyon Story	28 min.	color	J - S

How We Know About the Ice Ages	16 min.	color	I - J
Great Lakes: How They Were Formed	11 min.	color	J or S
Cascade Mountains	20 min.	color	I thru A
Volcanoes in Action	12 min.	b & w	I - J
Earthquakes and Volcanoes	14 min.	color	I or J
Face of the Earth	12 min.	color	J - I

See film catalog for additional films.

Filmstrips:

Fs 551	Changes in the Earth's Crust	J
Fs 551	Changing Face of the Earth	J
Fs 551	IGY: International Geophysical Year	I thru A
Fs 551	Story of Mountains	I thru A
Fs 551	Geomorphology: The Orgin and Development of Land Forms (6 Fs, Manual)	I - J
Fs 551.21	Story of Volcanoes	I thru A
Fs 551.31	Study of Ice and Glaciers	I or J

See audio-visual catalog for additional listings.

Slides:

551.2	2x2	Work of the Earthquakes and Volcanoes	I thru A

Study Prints:

SP-M 917.9498	San Diego County--Relief Map
SP-M 912	Relief Map of San Diego County
SP-M 551.31	Glaciers
SP-M 551.3	Erosion
SP-M 551.21	Land Forms of Running Water

INSCHOOL MATERIALS:

Map, World, Political Physical

CLASSROOM ACTIVITIES:

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 46-48.
2. Use a transparency to point out places where there are features of geologic interest in San Diego County, for example, Mount Soledad; the beach drifts in Kearny Mesa and Torrey Pines, and how they have influenced erosion by water; the formation of Crown Point from materials that have washed down from Mount Soledad; fossils on Crown Point, along Pacific Beach and other places; the formation of Mission Beach from ocean currents from north-west; formation of the Silver Strand by diverted currents that have carried materials up from the mouth of the Tia Juana River; the jetty of North Island preventing the channel from filling, the levee built from Old Town to Point Loma to divert the San Diego River to prevent deposition in the San Diego Bay, etc.
3. Use a relief map to show the courses and effects of large rivers.
4. Make a transparency of a world map for overhead projector or use a world map to show areas of earthquakes. Compare them to areas of volcanoes.
5. What forces in nature cause the weathering of rock?
6. Discuss evidence that our continent was not always the same as it is today.

Activities Suggestions:

1. Have students gather information to show that the earth's crust is constantly undergoing diastrophism or movement.
2. Have a student explain the cause of earthquakes and how a seismograph works.
3. Have students report on famous volcanoes and glaciers.
4. Have reports on the Grand Canyon and its origin, the geological history of San Diego, the history of the San Diego River, and so forth.
5. Look for examples of erosion in the area near your school.
6. Have a student get soil conservation information about San Diego County from the local Department of Agriculture office.
7. Soak a piece of limestone and a piece of sandstone in water overnight. Remove from the water and dry with a paper towel. Now freeze both rocks for 24 hours. Examine the rocks just after the freezing time is over. Let the rocks thaw. Examine the rocks again.

8. Demonstrate how limestone can be dissolved by the action of acid. Use diluted hydrochloric acid (one part standard solution to ten parts water). Place marble chips in a container with the acid or use a medicine dropper and place drops of acid on limestone. Explain that carbon dioxide from air dissolved in water produces an acid as does certain biological decay.

9. Have students report on Project Mohole and San Diego's part in its activities.

10. Have students report on IGY, International Geophysical Year.

THE CRUST OF THE EARTH

Chapter 9

LEARNING OBJECTIVES:

To learn about the different types of rocks in the crust and about the rock cycle.

To become aware of methods used to process mineral ores.

To see what types of fuel we obtain from the earth's crust and how they are prepared for use.

TEXT REFERENCES:

Herron and Palmer, pages 152-165.

Herron and Palmer, Teacher's Guide, pages 50-55.

Brooks, et. al., pages 128-179, 455-461.

Smith and Lisonbee, pages 364-383.

RESOURCE MATERIALS:

American Petroleum Institute has prepared the booklet, Teacher's Resource Reference, which lists free teaching materials related to the petroleum industry. Requests may be addressed to:

Oil Information Committee
Western Oil and Gas Association
609 South Grand
Los Angeles, California 90017

Hertlein, L. G. and U. S. Grant, IV, The Geology and Paleontology of the Marine Pliocene of San Diego, California, Volume II, Part I, Geology, San Diego, California, printed for the San Diego Society of Natural History, 1944.

Joseph, et. al., Teaching High School Science: A Sourcebook for the Physical Sciences, Harcourt, Brace and World, Inc., 1961.

American Geological Institute, Geology and Earth Sciences Sourcebook for Elementary & Secondary Schools, Holt, Rinehart and Winston, Inc., 1962

Teacher may visit: County of San Diego
Department of Agriculture
5555 Overland Avenue, Building 3
San Diego, California

Telephone: 298-9200, ext. 491

This agency provides literature explaining what is currently being done in this area in the way of soil conservation. There is also literature available on resources in San Diego County. Sample rocks and minerals of San Diego County may be obtained there.

By request on school letterhead paper, each school will be furnished one set of rocks and minerals of California along with a guide for their use. (Make sure your school has not previously received one before ordering.)

Order from: State of California
Department of Natural Resources
Division of Mines
Ferry Building
San Francisco, California 94111

AUDIO-VISUAL MATERIALS:

Films, Part I:

Conservation of Natural Resources	12 min.	b & w	I - J
World at Your Feet	22 min.	color	I - A
Permanent Agriculture	30 min.		I - A

See audio-visual catalog for additional listings.

Part II:

Our Natural Resources	10 min.	color	I - J
Treasures of the Earth	11 min.	color	I - J
Rocks and Minerals	10 min.	color	I - J

See audio-visual catalog for additional listings.

Part III:

Drilling for Oil	22 min.	color	I thru A
Birth of an Oil Field	31 min.	color	I thru A
Story of Gasoline, Rev. Ed.	23 min.	color	J thru A
Miracle Flame	20 min.	color	I thru A
Detergents from Petroleum	13 min.	color	I thru A

See audio-visual catalog for additional listings.

Part IV:

Prehistoric Animals of the Tar Pits: Story of Rancho La Brea	12 min.	color	S - J

Our Changing Earth	13 min.	color	I or J
Fossils: Clues to Prehistoric Times	11 min.	color	I thru A

See audio-visual catalog for additional listings.

Filmstrips:

Fs 631.4	How Soil is Formed	J thru A
Fs 631.4	How Man Conserves the Soil	J thru A
Fs 631.45	Wasted Soil and Water	I thru A
Fs 622.33	Coal Mining	
Fs 622.363	Salt	
Fs 338	Petroleum in Today's Living	

See audio-visual catalog for additional listings.

Study Prints:

SP-M 522	Igneous and Metamorphic Rocks
SP-S 665.5	Distillation
SP-S 665.5	Chemistry of Petroleum Refining
SP-S 662.62	Coal
SP-M 552	Common Rocks and Rock-forming minerals
SP-M 549	Important Minerals

INSCHOOL MATERIALS:

Minerals, Scale of Hardness (Nonstock MIN-5000)
Fluorescent Minerals Kit (Nonstock MIN-5050)

CLASSROOM ACTIVITIES:

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 51-54.
2. Discuss the distribution of minerals and fuels as related to the troubles and disagreements among the governments of the world.
3. Why are mineral materials important to man? Think of as many reasons as you can.

4. How many different types of occoupations can you think of that have something to do with the study of rocks and minerals? (Mining, road building, architecture, etc.)

5. Is it important for an architect or builder to understand something about the rocks of the earth? Discuss landslides in cuts in Soledad area.

6. Discuss needs and methods for soil conservation.

7. What changes in living may occur if we exhaust our limited supplies of coal, oil, and gas?

8. Using maps or transparencies, locate regions in the world and leading states in the U. S. where oil is abundant.

9. Discuss our dependence upon oil.

10. Discuss fractional distillation, cracking, octane rating and ring, sidechain and straight chain hydrocarbons.

11. Where is our coal supply obtained? Use map or transparency to locate the principal sources. Try to find information in the library on estimates of how much longer the supply will last at the present rate of consumption.

12. Discuss the processing of coke and charcoal. Why is coke used in making steel?

13. What advantages do you have in using natural gas as a fuel?

14. Discuss the origin and formation of coal.

15. In how many ways do you make use of minerals and fuels each day? Would their absence make much difference in the way you live?

Activities Suggestions:

1. Show the class a mineral collection. Find out how many of the minerals can be identified without further study. Later give everyone in the class an opportunity to study the collections. (Each school should build up its own supply of collections for convenience and reference at any time during the year.) Have the pupils bring in their own collections and tell the class about them. Extreme care should be taken to guard against loss of valuable samples.

2. Students should be encouraged to visit the street level of the Museum of Natural History, which has an excellent display of local and world-wide minerals. Mineral and Gem Society, Spanish Village, Balaboa Park, usually has a good display of minerals and equipment related to mineralogy.

3. Class "Rockhounds" should be given opportunity to display and discuss their hobby.

2

4. Make a trip to a nearby cliff or canyon rim to study the formations and to look for fossils.

5. Have the pupils examine the soil at different depths where a new cut has been made for erecting buildings or putting in a new road. Make a sketch of the cut to show the different layers and show it to the class. How much topsoil is present? How much topsoil is present in our yards in San Diego?

6. Display news items which refer to oil as an important natural resource in international relations and trade.

7. Have a student report on the history of coal mining on Point Loma.

8. Reports on derivatives of coal for fuel and its uses in dyes, fabrics, medicines, and so forth will give added interest to this topic.

9. Have a report on bottled gases, their sources and uses.

10. *Crystal Growing*. The following crystals may be produced on the slide for observation through a microscope or to be projected through the bioscope. Refer to *Geology and Earth Science Sourcebook*, pages 27-28.

    a. *Sodium Chloride Crystals*. Use a small amount of water and continue to add salt, while stirring, until no more salt will dissolve. Add a drop of the solution to a flat microscope slide. The heat from your light source will usually be enough to dry the solution. Dark cubic crystals should appear at the edge of the drop. Polaroid filters do not help in this demonstration.

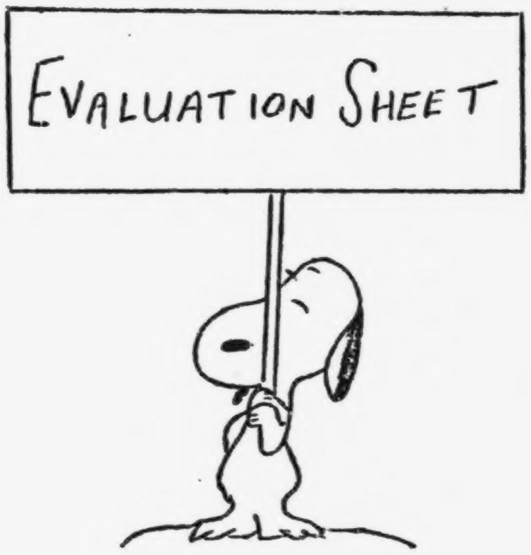
    b. *Silver Crystals*. Dissolve silver nitrate crystals in water. Place a small piece of copper foil on a flat side and add a few drops of silver nitrate solution to the edge of the copper. Crystals resembling frost patterns will appear if the concentration of the solution is great enough. CAUTION: Silver nitrate is poisonous.

    c. *Potassium Dichromate Crystals*. Dissolve potassium chromate crystals in water to form an orange solution. Yellow and orange crystals will form. Crossed polaroid filters will produce a dark background for the crystals. CAUTION: Potassium dichromate is poisonous.

    d. *Ammonium Chloride Crystals*. Place a drop of ammonium chloride solution on a flat slide. Branching crystals will appear.

Teachers' Evaluation of
of
Course Guide

UNIT NO. 5 *



1. List the title of any visual aids which you feel are inadequate or misplaced. (Specify)

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2. List any titles which should be added to the audio-visual list.

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3. List any demonstrations and/or laboratory exercises which proved unsatisfactory. Please explain.

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4. What additional demonstrations and laboratory exercises should be added to this unit? Please describe or submit draft.

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5. Which worksheet should be deleted or changed?

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6. What additional worksheets should be added to this unit? Please describe or submit draft.

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7. Other suggestions.

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*Please fill out this form on the completion of each unit. Completed forms should be sent to the Science Specialist, Room 2041, Education Center at the end of each semester during the school year 1966-67.

Unit Six

PLANTS AND ANIMALS

4 - 5 WEEKS

LIVING THINGS

Chapter 10

LEARNING OBJECTIVES:

To establish the ability to formulate accurately the similarities and differences in living things that can be used as a basis for classification.

To become familiar with the concept of the cell as the basic unit of life.

To learn to look for interrelationships among living things.

To become aware of the various ways in which different living things carry out life processes, such as reproduction.

To become familiar with the biological basis for heredity.

TEXT REFERENCES:

Herron and Palmer, pages 169-189.

Herron and Palmer, Teacher's Guide, pages 56-61.

Smith and Lisonbee, pages 19-27, 35-45, 53-54, 321-363, 396-407.

RESOURCE MATERIALS:

Schwab, Joseph J., Biology Teachers' Handbook, John Wiley and Sons, 1963.

WARD'S CULTURE LEAFLETS. Twenty-five different Culture Leaflets which provide information for the maintenance and use of live materials in the school laboratory (See p. 196, Ward's 1966-67 catalog) may be obtained by writing to:

Ward's of California
P. O. Box 1749
Monterey, California 93942

TURTOX SERVICE LEAFLETS. Single copies of any leaflet or one set of the Turtox Service Leaflets will be sent gratis to any biology teacher of secondary school or college level. Write to:

General Biological Supply House, Inc.
8200 South Hoyne Avenue
Chicago, Illinois 60620

Morholt, et. al., Teaching High School Science: A Sourcebook for the Biological Science, Harcourt, Brace, and Company, Inc., 1958.

Buchsbaum, R., Animals Without Backbones, New York, Chicago.

Jahn, Theodore L., How to Know the Protozoa, W. C. Brown, 1949.

Films, Part I:

Life in a Cell	14 min.	color	J thru A
Cell-Structural Unit of Life	10 min.	b & w	S - J
Fresh Water Pond	13 min.	color	I - J
Microscope and Its Use	10 min.	b & w	I - J
Amoeba	10 min.	b & w	S - C
Life in a Drop of Water	11 min.	color	J - S
Life Story of the Paramecium	11 min.	color	I thru A

Part II:

Characteristics of Plants and Animals	10 min.	color	S
Adaptations of Plants and Animals	10 min.	color	I - J
Behavior in Animals and Plants	11 min.	color	S - J
Reactions in Plants and Animals	11 min.	b & w	J

Part III:

Strands Grow	17 min.	color	I - J
Reproduction in Plants	13 min.	color	J thru A
From One Cell	12 min.	color	J thru A
Flowers at Work, Second Edition	11 min.	color	S
Life Cycle of the Frog	11 min.	b & w	S
Toads	11 min.	color	I thru A
Reproduction Among Mammals	12 min.	b & w	S
Development of the Chick	10 min.	b & w	S
Development of the Chick Embryo	5 min.	color	S

Part IV:

Mechanism of Inheritance	14 min.	color	J
Thread of Life, Part I	30 min.	color	S thru A
Thread of Life, Part II	30 min.	color	S thru A

Human Heredity	23 min.	color	S
Heredity in Animals (Better Breeds)	10 min.	b & w	S
Heredity and Environment	10 min.	b & w	J - S
Heredity	12 min.	b & w	J - S
How Living Things Change	11 min.	color	J thru A

See audio-visual catalog for more listings.

Filmstrips:

Fs 593	One-Celled Animals	I or J
Fs 574.8	Introducing Cells	S - J
Fs 574	Importance of Air in Nature	J - I
Fs 574	Introducing Biology	S - J
Fs 574.11	Securing Continued Existence	J
Fs 580	How New Plants are Produced	J
Fs 575.92	Darwin Discovers Natures Plan	J thru A
Fs 575.1	Gregor Mendel	S - J
Fs 591.55	Symbiosis: Strange Partners in Nature	J thru A
Fs 574.5	Natives of the Parks	I thru A

Kits:

Genetics Kit (Order through Instructional Aids Center, Mr. Mahoney, 298-4681, Ext. 307)

INSCHOOL MATERIALS:

Models, Mitosis, Animal, Biology

Microslide Viewers, Biology

Microscopes, Biology

Microscope Slide Sets, Botanical, Biology

Microscope Slide Sets, Zoological, Biology

Microtome Knife and Back, Biology

Microtome Knife Handle, Biology

Microtome, Table, Handoperated, Biology

PTC Leaflets (Taste Papers), (Nonstock PTC-8000), Biology

See Class 46 Life Science Nonstock Catalog.

CLASSROOM ACTIVITIES:

Recommended Laboratory Exercise: Use and Care of the Microscope, see Appendix page 268.

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 57-60.
2. Compare each of the life processes of animals with the life processes of plants to show that they are the same, but are accomplished in different ways.
3. In what ways are living and non-living things alike? How do they differ?
4. In what ways are plants and animals alike? How do they differ?
5. Higher animals have sense organs. How can lower animals and plants respond to stimuli without sense organs? Discuss.
6. Discuss the relative importance of heredity and environment in the development of an organism.
7. A flower-grower of San Diego County is trying to develop a new strain of flower. What kinds of characteristics will he be trying to produce. Example: new colors or color patterns, resistance to disease, fullness of flower, texture, and hardiness in the field and in shipping.
8. Discuss hemophilia and why it was called a disease of royalty.
9. Discuss natural and induced mutations. What is the difference between a mutant and a hybrid?

Activities Suggestions:

1. Gather evidence to prove that each of the following life functions occur in both animals and plants: growth, motion, digestion, reproduction, response to stimuli, respiration, and elimination of wastes.
2. Observe whether a candle flame illustrates the same functions listed above. Is it a living thing?
3. Place a few scraps of fine copper wire on a slide, and mount under a microscope or microprojector. Now add a drop of silver nitrate and watch the "growth" of crystals. Compare this with growth as applied to living things.

4. Obtain prepared slides of muscle, bone and nerve cells. Identify the various parts of a cell in each case and note the similarities, as well as the wide difference of structure, of the different kinds of cells.

5. Have students bring flowers to class to study the flower parts and adaptations for attracting insects. Dissect them and observe the reproductive parts. See Appendix page 231 for worksheet Parts of the Flower.

6. Have the students test some of their own inheritance traits and then compare these same traits with those of their parents. Use the student worksheet entitled Variation Chart (See Appendix page 229). The same chart can be used several times by the student, but additional taste papers will be needed for parent participation.

7. Have students report on the theories of evolution proposed by Lamarck and by Darwin. Discuss how chromosomes and DNA relate to these theories.

8. Mutations produce changes or modifications in living things and are responsible for a great many variations in life. Discuss hereditary and inheritance traits as related to the students and also several mutations and the aspect of dominance and recessiveness. Use student study sheet entitled Hereditary Characteristics of Man. (See Appendix page 222.)

9. Have students report on the effects of radiation on the genes and possibly the inheritance of future generations.

10. If possible, obtain fertilized eggs of water snail, grunion, starfish, or sea urchin. Make periodic observations of development using a microscope.

11. Have a student make a report on plant or animal breeding as a profession. Materials are available in the library.

12. Visit the Human Reproduction and Genetics display at the Museum of Man in Balboa Park.

13. Have a student report on "lethal genes."

THE PLANT KINGDOM Chapter 11

LEARNING OBJECTIVES:

To acquaint the student with the process and purpose of scientific grouping.

To point out the uniqueness of the food-getting process utilized by plants.

To give the student the structural and functional bases for the life processes carried on by a living organism.

To acquaint the student with the great diversity of kinds of organisms in the plant kingdom.

To show students the many ways in which the plant kingdom affects our everyday life.

To arrive at the conclusion that all food ultimately comes from plants.

TEXT REFERENCES:

Herron and Palmer, pages 190-206.

Herron and Palmer, Teacher's Guide, pages 61-65.

Smith and Lisonbee, pages 48-52, 65-70, 76-109.

RESOURCE MATERIALS:

Schwab, Joseph J., Biology Teachers' Handbook, John Wiley and Sons, 1963.

Morholt, et. al., Teaching High School Science: A Sourcebook for the Biological Sciences, Harcourt, Brace and Company, Inc., 1958.

AUDIO-VISUAL MATERIALS:

Films, Part I:

Carnivorous Plants	10 min.	color	S
Miracle of Moss	10 min.	b & w	I thru A
Bacteria - Friend and Foe	11 min.	color	I thru A

Part II:

Photosynthesis: Chemistry of Food Making	14 min.	color	S
Growth of Seeds	13 min.	color	J or S
Seasonal Changes in Plants	11 min.	color	I thru A

Secrets of the Plant World	15 min.	color	I thru A
Roots of Plants, Second Edition	13 min.	color	J - I
Plant Life at work	10 min.	color	J or S
Mysteries of Plant Life	18 min.	color	J - S
Life of a Plant	10 min.	color	J - S
Leaves	11 min.	b & w	S - J

Part III:

Seeds of Destruction	9 min.	color	I - J
Strand Breaks	17 min.	color	I - J
Nature's Half Acre	33 min.	color	all gr.
Chain of Life	11 min.	color	S - J
Grasslands	17 min.	color	S - C
Life in the Grasslands	11 min.	color	I thru A
Chaparral: The Elfin Forest	17 min.	color	I - J
Forest Conservation	11 min.	color	I - J
Importance of Water	11 min.	b & w	I - J
Redwood Trees	15 min.	color	I thru A
California and Its Natural Resource	40 min.	color	I thru A
Valleys	10 min.	color	I or J
What is Cloth	10 min.	color	J or S
American Loomed Wool on Parade	14 min.	color	S thru A

See audio-visual catalog for additional listings.

Filmstrips:

Fs 546.71	Nitrogen Fixation	S - C
Fs 580	Introducing Plants	S - J
Fs 580	Luther Burbank: Plant Wizard	I - J
Fs 580.92	Carolus Linnaeus	S - J

Fs 581.1	Green Plants: Food Factories for the World	J
Fs 677.7	Silk Thread Manufacturing	I - J
Fs 581.5	Forest Plant and Animal Relationships	
Fs 574.9	Desert Life Community	I - A

Transparencies:

Trns	Botany	I - A

Study Prints:

SP-M	How a Tree Grows	I - A
SP-M	Interdependence of Animals and Plants	I - J
SP-S	Wild Flowers of the West, Set A	I - A

Kits:

Genetics Kit

INSCHOOL MATERIALS:

Microslide viewers, Biology

Microscope Slide Sets, Botanical, Biology

Microscopes, Biology

Microtome Knife and Back, Biology

Microtome Knife Handle, Biology

Microtome, Table, Hand Operated, Biology

Capillary Apparatus, (Nonstock CAP-2000), Chem, Physics, Biology

Press, Plant, (Nonstock PRE-2500), Biology

C. E. R. Oceanography Kit

CLASSROOM ACTIVITIES:

Recommended Laboratory Exercise: Plant Structures, see Appendix page 273.

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 62-64.
2. Discuss places where students may go in San Diego to study plant life, e.g., Balboa Park, nature trails at Torrey Pines, mountains, canyons. The plant life as they go to school, their own back and front yards. Use a transparency map to show the location of some of the better places.
3. Discuss features of roots, stems, leaves and flowers.
4. Compare oxidation or respiration and photosynthesis in regards to products, time of occurrence, location in plant.
5. Discuss food chains and show how they relate back to the algae and fungi.
6. What are the harmful and beneficial aspects of bacteria and other fungi to living things?
7. Discuss the importance of agriculture to the economy of San Diego County. Farms, truck farms, flowers, fruit all contribute quite significantly.
8. Discuss symbiotic, parasitic and saprophytic relationships and the importance of these organisms in maintaining food chains.
9. Why would you not vote to have all bacteria eliminated?
10. What is the importance of chlorophyll?

Activities Suggestions:

1. Plan a field trip into one of the canyons near your school to study the plant (and animal) life.
2. Obtain a planting schedule of the landscaping around your school from the custodian and plan a trip around the school observing such things as: (1) the kinds of plants, (2) similarities and differences in the plants, and (3) the contribution of plants to the appearance of the school.
3. Have students make an outline of the parts of the plant, showing the part each plays in producing food.
4. Have students complete the worksheet, The Parts of a Stem, see Appendix page 233. Discuss their work.
5. Have students study the root hair by putting some radish seed on moist paper in a petri dish, and allowing time for the seen to germinate. After a few days, observe the root hairs as suggested in the text on page 491. Have students complete worksheet, The Parts of a Root, see Appendix page 232.

6. Experiment with geotropism by planting bean seeds on the side of a beaker supported by blotting paper. When the plants are mature enough to show directional tendencies, turn the plant upside-down by inverting the beaker.

7. Carefully tear the epidermal layer from the surface of a leaf, ice plant, or iris, calla lilly, or other smooth-leafed plant. Make a water mount and observe under the microscope. Note the stomates and compare cell structure. Have students complete and discuss worksheet, The Parts of a Leaf, see Appendix page 234.

8. Dissect a bean seed. Identify the plumule, hypocotyl seed coat and cotyledon.

9. Plant collections may be made by students. Suggested collection types are conifers, food plants, grasses, native shrubs, ornamental shrubs, fruit trees, and so forth. Specimen leaves can be mounted on cardboard with tape and labels attached. Handbooks for identification are available in the library.

10. Make an outline on the board using headings such as "Herbivorous," "Omnivorous," "Insectivorous," and "Carnivorous." Under each heading list animals with that particular type of food habit. From this information, show how food chains are developed. Be sure to discuss carnivorous plants and explain their use of insects, and so forth, in their diet. One common example in most gardens is the petunia. Examine the surfaces of their leaves.

11. Have students get information on the food habits of the grey whale as a study of food chains. Use the filmstrip from the C. E. R. Oceanography Kit to illustrate food chains in the ocean.

12. Use the Genetics Kit available through the Audio-Visual Distribution Center to study human genetics.

13. Cut sections through various fruits and have the students identify the calyx, seeds, and ovules.

THE ANIMAL KINGDOM

Chapter 12

LEARNING OBJECTIVES:

To acquaint the student with the diversity of the animal kingdom.

To realize that living things are classified in a rational, logical manner to facilitate study.

To learn what structures or characteristics are used to classify or group animals.

To become familiar with the principles of conservation.

TEXT REFERENCES:

Herron and Palmer, pages 207-219.

Herron and Palmer, Teacher's Guide, pages 65-68.

Smith and Lisonbee, pages 55-62, 71-73, 421-428.

RESOURCE MATERIALS:

Morholt, et. al., Teaching High School Science: A Sourcebook for the Biological Sciences, Harcourt, Brace and Company, Inc., 1958.

Schwab, Joseph J., Biology Teachers' Handbook, John Wiley and Sons, Inc.

Buchsbaum, R., Animals Without Backbones, University of Chicago.

Jahn, Theodore L., How to Know the Protozoa, W. C. Brown, 1949.

AUDIO-VISUAL MATERIALS:

Films, Part I:

Animals That Live in the Surf	11 min.	color	I thru A
Life Story of the Sea Star	11 min.	color	I thru A
Life Story of the Snail	10 min.	color	I thru A
Life Story of the Earthworm	10 min.	color	I thru A
Insect Collecting	14 min.	color	I thru A
Rival World	27 min.	color	J thru A
Part II:			
Sea Otter	11 min.	color	I thru A

Frog, Second Edition	11 min.	color	S - J
World of Water	10 min.	color	I thru A
Fish Out of Water	11 min.	color	I thru A
How Nature Protects Animals, Second Edition			I thru A
Food-Getting Among Animals	14 min.	color	I thru A
Beaver Valley	32 min.	color	I thru A

Part III:

Adventuring in Conservation	15 min.	color	I - J
Breaking the Web	10 min.	color	I - J
Wildlife and the Human Touch	18 min.	color	I thru A
Animal Habitats	11 min.	color	I - J
Life in the Desert	11 min.	color	I - J
Camouflage in Nature Through Form and Matching, Second Edition	11 min.	color	I thru A

Filmstrips:

Fs 590	Animal Pests	I or J
Fs 590	Life in the Wild	I thru A
Fs 551.45	Living Desert	I thru A
Fs 551.45	Our Desert Treasure	I thru A
Fs 441.45	Vanishing Prairie	I thru A
Fs 574.5	Helpful and Harmful Insects	I - J
Fs 591.92	Life in Ponds, Lakes and Streams	I thru A
Fs 592	Introducing Invertebrates	S - J
Fs 590	Animals Struggle to Live	I or J
Fs 590.1	How Animals are Classified	J
Fs 596	Introducing Vertebrates	S - J

Slides:

591.92	2x2	Small Creatures of the Ocean	I thru A

Study Prints:

SP-M 560	Evolution of Life	S
SP-M 563.19	Prehistoric Life	I thru A
SP-M 595.7	Common Insects, Group 1	all gr.

INSCHOOL MATERIALS:

Insect Spreading Board, (Nonstock BOA-7100), Biology

Micro Slide Viewers, Biology

Microscope Slide Sets, Zoological, Biology

CLASSROOM ACTIVITIES:

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 66-67.
2. Discuss the characteristics of each class of invertebrates and relate how they are important to the animal's survival.
3. Explain what is meant by metamorphosis. Explain the kind of metamorphosis the grasshopper has as compared to the bee or the butterfly.
4. Discuss why insects, both harmful and beneficial, are so important among the living things of the earth.
5. Discuss the characteristics of each of the various classes of vertebrates. Make a list of animals under each class, giving the kind of food and habitat of each.
6. Have students make reports on various fish. Discuss the possibility of ancient fish that are in areas of the water yet unexplored by scientists.
7. Discuss reasons for establishing game laws governing the season and limiting the number of animals which may be taken. Include laws concerning commerical ocean fishing.
8. Discuss or have students report on the fish of our region and how they are being caught. Study the Tuna Industry in San Diego.
9. Discuss the National Forests and their part in conservation.

Activities Suggestions:

1. Have students study and observe protozoa and/or other small animals using the microscope. See Class 46 of the nonstock catalog for cultures that may be purchased or produce a variety of microscopic life by putting some dry hay or grass in a beaker of water for several days.

2. Make a study of the earthworm. Perform several experiments such as observing the reactions of earthworms when placed upon a large dish prepared with dry paper on one half and wet paper on the other. Check the reaction of the animal when a match dipped in ammonia is held near the head of the earthworm without touching it.

3. Students can make a collection of harmful or beneficial common insects and mount and label them for display. Handbooks are available in the library.

4. Have students write reports on interesting spiders or other Arachnida.

5. Encourage your students to visit the San Diego Zoo and spend extra time observing the characteristics and habits of certain animals. Have them write reports of their observations.

6. Have students study the animals which have been prepared in plasticized mounts or formaldehyde available in the biology department.

7. Have students report on the history of Torrey Pines Park and its part in conservation.

8. Have students report on various societies and agencies for conservation of plants and animals.

9. Encourage the students to visit tide pools in the area, but emphasize the importance of leaving the area as it was before they arrived, e.g. Return rocks to their original positions.

10. Invite a speaker from the U. S. Forest Service to discuss conservation work and occupational opportunities in the Forest Service.

11. Display a map of California, using string attached to name cards, showing the locations of state and national park areas where wild life conservation is maintained.

Teachers' Evaluation of
of
Course Guide

UNIT NO. 6 *

EVALUATION SHEET

1. List the title of any visual aids which you feel are inadequate or misplaced. (Specify)

2. List any titles which should be added to the audio-visual list.

3. List any demonstrations and/or laboratory exercises which proved unsatisfactory. Please explain.

4. What additional demonstrations and laboratory exercises should be added to this unit? Please describe or submit draft.

5. Which worksheet should be deleted or changed?

6. What additional worksheets should be added to this unit? Please describe or submit draft.

7. Other suggestions.

*Please fill out this form on the completion of each unit. Completed forms should be sent to the Science Specialist, Room 2041, Education Center at the end of each semester during the school year 1966-67.

Unit Seven

THE HUMAN BODY

4 - 5 WEEKS

NUTRITION FOR THE BODY

Chapter 13

LEARNING OBJECTIVES:

To become aware that nutrients are the basic components of all foods.

To learn the functions of nutrients in the body.

To understand how energy is utilized at the cellular level.

To learn how to plan a balanced diet.

To be able to recognize foods that are not adequately prepared and preserved, and that are therefore unsafe for human consumption.

TEXT REFERENCES:

Herron and Palmer, pages 221-233.

Herron and Palmer, Teacher's Guide, pages 68-72.

Smith and Liscnbee, pages 112-141.

RESOURCE MATERIALS:

HEALTH PUBLICATIONS FROM THE PHARMACEUTICAL INDUSTRY. Catalog available from:

Pharmaceutical Manufacturers Association
1155 Fifteenth St., N.W.
Washington, D. C. 20005

Contains description of more than 150 publications produced in the public interest by manufacturers of prescription drugs. It is intended to aid and inform teachers, students, public speakers and others who desire health information in preparing assignments, studies and statements.

DAIRY COUNCIL OF CALIFORNIA each year submits a list of Educational Materials for Senior High School related to nutrition. They are available in this area from:

Dairy Council of California
4604 University Avenue
San Diego, California 92105

Schwab, Joseph J., Biology Teachers' Handbook, John Wiley and Sons, 1963.

Morholt, et. al., Teaching High School Science: A Sourcebook for the Biological Sciences, Harcourt, Brace and Company Inc., 1958.

AUDIO-VISUAL MATERIALS:

Films, Part I:

Foods and Nutrition	12 min.	b & w	S - J
Fundamentals of Diet	11 min.	b & w	J or S

Golden Foods	20 min.	color	I thru A
Understanding Vitamins	14 min.	color	S - J
V-Men	17 min.	b & w	J thru A
How the Body Uses Energy	15 min.	color	J - S

Part II:

Better Breakfasts, U. S. A.	11 min.	color	I thru A
Four Food Groups	11 min.	color	J
Modest Miracle	30 min.	b & w	J thru A
Nutritional Needs of Our Bodies	11 min.	color	J
Preserving Food	10 min.	b & w	J or S
Why Foods Spoil	14 min.	color	I or J
Freeze It	16 min.	color	J or S
Big Freeze	11 min.	color	S - J

Filmstrips:

Fs 613.2	Food for Life	J - S
Fs 613.2	More Milk in our Meals	J or S
Fs 615.328	Disease and Diet	I thru A
Fs 614.3	Safeguarding Our Food	I thru A
Fs 613.2	You and Your Food, Copy B	I - J
Fs 613.2	Why Eat a Good Breakfast?	P thru S

Soundstrips:

Ss 613.2	Good Food--Good Health--Good Looks	color	J or S

INSCHOOL MATERIALS:

Calorimeter, (Nonstock CAL- 8000), Bio, Chem, Physics

CLASSROOM ACTIVITIES:

Recommended Laboratory Exercise: Measurement of Heat Produced by Burning Fuel, see Appendix page 277.

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 69-70.
2. Discuss the "Basic Four" food groups.
3. Why must food be constantly supplied to the body?
4. What do vitamins actually do for the body?
5. To what extent has the taking of vitamin pills become a health fad?
6. What combinations of food will provide vitamins to meet normal health requirements and at the same time supply other dietary needs?
7. What happens when you get more vitamins than your body needs?
8. Why is breakfast such an important meal? What foods constitute a good breakfast?
9. Compare the nutritional value and cost of a school lunch with a cold or sack lunch.
10. How does the owner of a food processing plant react to inspectors checking on his preparation and packing procedures?
11. Many people who suffer from "fork and mouth disease" (being overweight) are people who live to eat, rather than those who eat to live. Someone has commented that many people dig their graves with knives, forks, and spoons. Discuss the elements of truth in these statements.

Activities Suggestions:

1. Have each student make an accurate record of the kind and amount of every bit of food he eats in a typical 24-hour period. Let him use his list to make a chart illustrating the classes of food he has eaten and the kinds of vitamins and minerals present in each. Your home economics department will have books or charts on food values which you may want to borrow. Use the "typical diet" list and table 7, Calories in Foods, page 135, Smith and Lisonbee in a calorie study. Have students compare their results with some of the standard calorie requirement lists.
2. Order some of the free materials available from the Pharmaceutical Industry. See RESOURCE MATERIALS for this chapter.
3. Girls in the class have had home economics and should be able to contribute significantly to this chapter. Give them opportunities to make special reports, prepare bulletin boards, or lead topical discussions.
4. Invite the school nurse or a professional dietitian to speak on classes of food and body requirements, or vitamins and minerals.

5. Plan with your cafeteria manager to visit the school cafeteria kitchen to learn how menus are planned and foods obtained and prepared.

6. Have students report on scurvy, rickets, pellagra, beriberi and other deficiency diseases.

7. Have students report on basal metabolism rate and its use in medicine and physiological research.

8. Test foods for the different kinds of food nutrients. See Morholt, et. al., Teaching High School Science: A Sourcebook for the Biological Sciences, (page 36 in the 1958 edition).

9. Have a student gather information for a report on pure food laws regarding handling, preparation, adulteration and sale of foods.

10. Have a student report on the significance of the "A" or "B" sign which is displayed at public eating places.

11. Have a student contact the office of the County Medical officer to obtain literature concerning preparation, preservation and sale of food.

RAW MATERIALS FOR THE BODY

Chapter 14

LEARNING OBJECTIVES:

To learn how the body processes food and makes its energy available to the body cells.

To develop an understanding of the role of the circulatory system in transporting nutrients, oxygen, and waste materials.

To learn some of the mechanics involved in transporting food and oxygen through the body.

To understand how the body eliminates materials it cannot use.

TEXT REFERENCES:

Herron and Palmer, pages 234-245.

Herron and Palmer, Teacher's Guide, pages 72-76.

Smith and Lisonbee, pages 142-153, 158-184, 193-203.

RESOURCE MATERIALS:

Morholt, et. al., Teaching High School Science: A Sourcebook for the Biological Sciences, Harcourt, Brace and Company, 1958.

Schwab, Joseph J., Biology Teachers' Handbook, John Wiley and Sons, 1963.

AUDIO-VISUAL MATERIALS:

Films, Part I:

Moving X-rays	10 min.	b & w	S - J
About the Human Body	15 min.	color	I - J
Alimentary Tract	12 min.	b & w	S - J
Digestion in Our Bodies	11 min.	color	J - I
Exploring Your Growth	11 min.	color	J - I
Human Body: Digestive System	14 min.	color	J - S

Part II:

Healthy Lungs	10 min.	b & w	J - S
Heart, Lungs, and Circulation	11 min.	color	I - J

Circulation, Why and How	10 min.	color	I - J
Hemo, The Magnificent, Part I	30 min.	color	S thru A
Hemo, The Magnificent, Part II	30 min.	color	S thru A
Circulation	16 min.	color	J - S
Control of Body Temperature	12 min.	b & w	S - J
Mechanism of Breathing	11 min.	b & w	S - J
Work of the Kidneys	11 min.	b & w	S - J

Filmstrips:

Fs 612.3	Food in the Body, Parts A and B	J
Fs 612.3	Human Digestive System	S - C
Fs 612.3	Your Digestive System	I thru A
Fs 612.1	How the Heart Works	J or S
Fs 612.13	Harvey and Blood Circulation	I thru A
Fs 612.1	Your Heart and Circulation	J or S
Fs 612.2	Human Respiration	J or S
Fs 612.2	Your Lungs and How You Breathe	I thru A

See audio-visual catalog for more listings.

Transparencies:

Trns	Anatomy	I thru A

INSCHOOL MATERIALS:

Chart, Carlsen, Physiology, Biology

Model, Anatomical Heart, Biology

Model, Anatomical, Biology

Sphygmomanometer (Blood Pressure Gauge), Biology

Stethoscope, (Nonstock STE-5100), Biology

Lancets, Blood, Disposable, (Nonstock LAN-0510 or 0511), Biology

SERA, Blood Typing, Anti-A and Anti-B, (Nonstock SER-0500), Biology

CLASSROOM ACTIVITIES:

Recommended Laboratory Exercise: The Circulatory System, see Appendix page 282.

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 72-74.
2. Use the model of the human torso to observe the position, size and structure of the digestive system.
3. Why is food-chewing an important first step in digestion?
4. Where is food digestion finally completed?
5. Discuss the important facts about food color and taste. Do they affect digestion?
6. Discuss the value or importance of a pleasant, relaxed environment at mealtime.
7. What are some of the digestive tract diseases and their causes? (ulcers, appendicitis, acid stomach, dysentery, worms, colitis, diabetes, gall stones, constipation, etc.)
8. Study the model torso to observe the position, size, and structure of the heart and lungs. Point out the importance of their being so closely related in order to provide a continual oxygen-carbon dioxide exchange to all body cells.
9. What are the four main parts of the blood and what is the function of each part? Why is blood called a tissue?
10. What about lung and heart diseases? Which ones can be avoided? Student reports or class discussion based upon outside reading will make this an interesting topic.
11. What is uremic poisoning? Why do severly burned persons suffer, and sometimes die, from this?
12. Discuss the liver as a gland and as an excretory organ. Why is liver considered an important food item?
13. Briefly discuss the four kinds of elimination of body wastes.
14. What effect does strenous exercise have on breathing? Why is this necessary? What materials are exchanged? Can respiration and the burning of a candle be compared?
15. Discuss the values of elimination through the skin to rid the body of waste, cool the body, and lubricate the skin. Point out the importance of cleanliness of the skin for health, comfort, and appearance.

16. Have students report on the values and dangers involved in the use of various skin preparations.

17. What kinds of elimination involves the blood? What kind does not?

18. What relationship exists between the amount of food intake, physical activity and elimination? Does this show that the human body is a combustion engine? Compare this with a car as to similarity and difference.

Activities Suggestions:

1. What is an enzyme? Have students demonstrate the action of the enzyme ptyalin by chewing an unsalted soda cracker and holding it in their mouths until the starch begins to taste sweet.

2. Complete worksheet, Digestive System, and discuss. See Appendix page 235.

3. Complete worksheet, Circulation, and discuss. See Appendix page 236.

4. Demonstrate a sphygmomanometer and stethoscope.

5. Use a microscope for examination of blood cells.

6. Bubble exhaled air through lime water to demonstrate presence of carbon dioxide.

7. Dissect untrimmed fresh pork or sheep kidneys so students can see the actual regions. Explain how urea passes from the blood into the kidney.

8. Have a student report on replacing of faulty hearts and blood vessels with substitutes.

9. Have a student report on artificial kidneys.

10. Have a student report on "Blood Banks". Have blood storage, preparation for shipment, various blood preparation that may be used for transfusions, blood that is not acceptable from donors and rare blood types included in the report.

11. Study blood types and have students type their own blood. See Laboratory Investigation 43 in the BSCS Biological Science: Molecules to Man, 1963, available from the library or the teacher of Advanced Biology.

THE STRUCTURE OF THE BODY Chapter 15

LEARNING OBJECTIVES:

To recognize the functions of the skeletal system.

To understand the adaptive value of cartilage to the body.

To become aware of the different kinds of joints utilized by the body to increase its mobility.

To learn to relate the functions of muscle and bone to each other.

To become aware of the variety of functions performed and regulated by the nervous system.

To understand how the nervous system and endocrine glands are interrelated.

TEXT REFERENCES:

Herron and Palmer, pages 246-255.

Herron and Palmer, Teacher's Guide, pages 76-79.

Smith and Lisonbee, pages 185-192, 206-232.

RESOURCE MATERIALS:

Morholt, et. al., *Teaching High School Science: A Sourcebook for the Biological Sciences*, Harcourt, Brace and Company, 1958.

Schwab, Joseph J., *Biology Teachers' Handbook*, John Wiley and Sons, 1963.

AUDIO-VISUAL MATERIALS:

Films, *Part I*:

Human Skeleton	11 min.	b & w	S thru A
Spinal Column	11 min.	b & w	S - C
Healthy Feet	11 min.	color	J - S
Posture Habits	10 min.	b & w	I - J
Posture in Motion	9 min.	color	J thru A

Part II:

Endocrine Glands	11 min.	b & w	S - J
Functions of the Nervous System	13 min.	b & w	J - S

Fundamentals of the Nervous System	16 min.	color	J thru A
Gateways to the Mind, Part I	30 min.	color	I thru A
Gateways to the Mind, Part II	30 min.	color	I thru A
Human Brain	11 min.	b & w	S - J
Nervous System	11 min.	b & w	S - J

__Filmstrips__:

Fs 612.7	Human Body Framework	S - C
Fs 612.7	Your Bones and Muscles	I thru A
Fs 612.74	Body Machine: Muscular System	S - C
Fs 612.8	Human Nervous System	S - C
Fs 612.8	Human Sense Organs	S - C
Fs 612.8	You and Your Five Senses	I - J
Fs 612.4	Excretion	S - J
Fs 612.4	Human Glandular System	S - C

__See audio-visual catalog for more listings__.

__Transparencies__:

Trns	Anatomy	I thru A

INSCHOOL MATERIALS:

Model, Anatomical, __Biology__

Skeleton, Human, __Biology__

CLASSROOM ACTIVITIES:

__Discussion Suggestions__:

1. See Herron and Palmer, Teacher's Guide, pages 77-78.
2. Discuss the functions of the human skeletal system.
3. Use the human skeleton to illustrate the locations and action of the various kinds of bones and joints.
4. Discuss evidence that bone is alive, just as muscle tissue is alive.

5. Discuss striated, smooth, and cardiac muscle, and illustrate where each is used.

6. Discuss and demonstrate the counteracting effect of muscles which permit standing, bending, lifting, and so forth.

7. Discuss what is involved in a pulled tendon, a strained muscle, tetany, paralysis, and poor coordination.

8. Do "muscle building" clinics or courses, as advertised in magazines, really work?

9. Use human torso model and charts to illustrate the nervous system, nerve structure and reflex arc.

10. What advantage has the upright position been to man's development?

11. Compared to other vertebrates, which parts of the human brain are more developed and which are less developed in relation to size? Explain.

12. Discuss the organs of the endocrine system and the importance of hormones in the human body.

Activities Suggestions:

1. Have students report on bone formation, injuries, and diseases.

2. Have students complete worksheet, Human Skeleton, and discuss. See Appendix, page 237.

3. Use prepared slides and muscles dissected from frogs to help explain how a muscle is constructed and how it is able to contract.

4. Student reports can include "Nerves Versus Tropisms," "First, Second and Third Level Reflexes," "Polio," "Paralysis," "What Is a Nervous Breakdown," "Tetanus," "The Cause and Treatment of Ulcers," "Memory," and "Location of Centers in the Brain."

5. Borrow a reaction-time test apparatus from the Driver Training teacher and demonstrate the response differences among members of the class.

6. Student reports may include "Diabetes - Cause and Control," "Goiters - Types, Cause," "Treatment and Effect on Behavior." Several students may each choose one of the endocrine glands and use the Reader's Guide in the library to report on the latest information or research regarding it.

7. Have students report on specific hormones used in medical practice.

8. Invite the school nurse or a doctor to discuss endocrine glands, what they do, and how modern medical science makes use of hormones.

MAINTAINING A HEALTHY BODY

Chapter 16

LEARNING OBJECTIVES:

To gain an understanding of the physiological basis of common terms used in connection with disease.

To learn how to avoid unnecessary failure of health.

To gain enough knowledge to overcome certain superstitious fears about diseases.

To acquire an appreciation of medicine through a knowledge of medical history.

To discourage habits which may cause permanent damage to mental and physical health.

To learn the methods of first aid which may save lives in emergency situations.

TEXT REFERENCES:

Herron and Palmer, pages 256-273.

Herron and Palmer, Teacher's Guide, pages 79-83.

Smith and Lisonbee, pages 153-157, 233-303.

RESOURCE MATERIALS:

HEALTH PUBLICATIONS FROM THE PHARMACEUTICAL INDUSTRY. Catalog available from:
Pharmaceutical Manufacturers Association
1155 Fifteenth St., N.W.
Washington, D. C. 20005

Contains description of more than 150 publications produced in the public interest by manufacturers of prescription drugs. It is intended to aid and inform teachers, students, public speakers and others who desire health information in preparing assignments, studies and statements.

Morholt, et. al., *Teaching High School Science: A Sourcebook for the Biological Sciences*, Harcourt, Brace and Company, 1958.

Schwab, Joseph J., *Biology Teachers' Handbook*, John Wiley and Sons, 1963.

A report prepared by the California Bureau of Narcotic Enforcement, *The Narcotic Problem*, may be obtained by writing to:
State of California
Department of Justice
Bureau of Narcotic Enforcement
P. O. Box 2630
Sacramento, California 95012

The American Cancer Society, 1405 5th Street, San Diego, (Telephone: 234-8481) will provide information relating to cancer, including the relationships between cancer and cigarette smoking.

AUDIO-VISUAL MATERIALS:

Films, Part I:

Common Cold	10 min.	b & w	I - J
Confessions of a Cold	9 min.	b & w	I - J
How to Catch a Cold	10 min.	color	all gr.
Signposts	15 min.	b & w	J thru A
Sniffles and Sneezes	10 min.	b & w	J or S
Cancer	12 min.	color	S - J
Traitor Within	10 min.	color	S thru A

Part II:

Gateway to Health	20 min.	color	I thru A
Winged Scourge	10 min.	color	I thru A
Malaria	24 min.	b & w	S thru A
Immunization	11 min.	b & w	S - J
Health Heroes: The Battle Against Disease	11 min.	color	I thru A
Infections, Diseases, and Natural Body Defenses	11 min.	b & w	J
Body Fights Bacteria	15 min.	b & w	S thru A
Body Defenses Against Disease	12 min.	b & w	J - S
Healthy Skin	11 min.	color	J - S

Part III:

Alchohol

Friendly Enemy	24 min.	b & w	J thru A
Pay OFF	20 min.	b & w	J thru A
Problem Drinkers	19 min.	b & w	J thru A

Verdict at 1:32	22 min.	color	J thru A
What About Alcoholism	10 min.	b & w	S

Tobacco

Tobacco and the Human Body	15 min.	b & w	S - J
One in 20,000	30 min.	color	J thru A
Is Smoking Worth It?	16 min.	color	J thru A
Huffless, Puffless, Dragon	8 min.	color	I or J
Emphysema		color	J thru A
Time Pulls the Trigger	25 min.	color	J thru A

Narcotics

Drug Addiction	22 min.	b & w	S thru A

Emotions and Health

Control Your Emotions	13 min.	b & w	J thru A
Planning for Success	10 min.	b & w	S - J
Snap Out of It!	14 min.	b & w	S - J
Facing Reality	12 min.	b & w	S thru A
Anger at Work	21 min.	b & w	S thru A

First Aid

First Aid, Part II, Everyday Emergencies	25 min.	b & w	S thru A
That They May Live, Copy B	27 min.	b & w	I thru A
First Aid on the Spot, Third Edition	10 min.	b & w	J thru A
50,000 Lives	14 min.	color	I thru A
Help Wanted	25 min.	b & w	S thru A

Filmstrips:

Fs 610.9	Man's Battle Against Disease	J - I
Fs 612.79	Face Facts	S

Fs 614.4	Control of Communicative Diseases	I thru A
Fs 614.4	Hidden Enemies in Your Home	I thru A
Fs 614.521	Jenner's Smallpox Vaccine	I thru A
Fs 613	Take Care of Your Health	I thru A
Fs 614.88	First Aid in Common Emergenices	J thru A
Fs 614.88	Your Responsibilities in First Aid	J thru A
Fs 613.7	Fit as a Fiddle	S - J
Fs 616.86	Dangers of Narcotics	J thru A
Fs 613.81	Chance of a Lifetime	J thru A
Fs 613.81	Celling Unlimited	J thru A

See audio-visual catalog for more listings.

Soundstrips:

Ss 613.81	I'll Choose the High Road	J thru A
Ss 613.81	To Smoke or Not to Smoke	J thru A

Study Prints:

SP-M 614.88	Do's and Don'ts of First Aid	S thru A

INSCHOOL MATERIALS:

Smoking and Health Kit, Biology or P.E.

CLASSROOM ACTIVITIES:

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 80-81.
2. List on the blackboard diseases caused by bacteria, those caused by protozoa and those not caused by germs.
3. When discussing each of the types of body defense, point out the conditions which weaken the defense and permit the invasion of disease germs.
4. Modern medicine is divided into many specialized fields which the students can learn by making a list on the board, identifying the kind of work each specialist does.

5. Discuss the difference between natural and acquired immunity.

6. What are some of the required health regulations when you apply for a passport to visit a foreign country such as India or China? Why should we in San Diego, a port city, be especially concerned about communicable diseases?

7. What health precautions should be taken when traveling to Mexico? Why are you not allowed to bring prepared foods across the border from Mexico?

8. Discuss some of the danger signals which might indicate heart disease and cancer.

9. Who conducts the medical research in the fight to control disease? Who pays the bill for research, and what happens to the new information gained?

10. Most people could learn, and do much more than they do, if they were willing to spend the time and effort to practice learning. Learning is the result of interest coupled with an effort to practice and remember.

11. What are some of the advantages of regular medical and dental checkups?

12. Discuss the values of being systematic in routine or daily activities. Show how a daily time budget can give greater efficiency in work and at the same time provide more leisure.

13. Discuss the factors which seem to influence people to start smoking such as: advertising, examples of people they respect, trying to make an impression, trying to be "one of the crowd."

14. Discuss the factors which seem to influence use of alcohol such as: advertising, social acceptance, custom. Include discussion of danger of glue-sniffing.

15. Discuss reasons for people becoming narcotics addicts. Be sure to include LSD in your discussion.

16. What kinds of narcotics are used for medical purposes and what care must be taken in their use?

17. Why is it important for everyone to know the basic elements of first aid?

Activities Suggestions:

1. Invite a medical laboratory technician to discuss the training and kinds of work done by a laboratory technician.

2. Have students report on topics such as human diseases spread by water, milk, insects, other animals, and food. Reports may include such topics as the history of smallpox, diphtheria, bubonic plague, polio, typhoid fever, tetanus, and so forth.

3. Report regulations in the San Diego City and County codes pertaining to health and sanitation.

4. Have one or more students make a survey of some of the things which might be done to improve insect control in the community.

5. Examine the body of a fly with a hand lens or dissecting microscope to observe surfaces upon which filth disease germs may become attached and transported. Discuss the life history of a fly.

6. Have students report on hypochondria and psychosomatic illness.

7. Show some of the films on emotions and health and spend several days developing this area. Show some of the films listed and have students give reports on various kinds of mental illnesses.

8. Use the Smoking and Health Kit as a resource unit to gather information concerning smoking, cancer, heart disease, etc. Perform some of the suggested demonstrations.

9. Have students write to the: Narcotics Enforcement Division of the Attorney General's Office, State of California, Sacramento for information on the narcotics problem.

10. Invite a member of the Police Department to discuss police problems involving alcohol and narcotics.

11. Assign students to consult the Reader's Guide and read current articles as a basis for reports on the recent studies on narcotics, tobacco, and alcohol.

12. Collect newspaper items dealing with alcohol, narcotics, and tobacco. Post them on a bulletin board.

13. Have students collect clippings from newspapers for one week which give accounts of accidents in homes. Which kinds are most frequent? Which do you think could have been avoided?

14. Invite the school nurse to discuss her activities and responsibility regarding first aid.

Teachers' Evaluation of
of
Course Guide

UNIT NO. 7 *

EVALUATION SHEET

1. List the title of any visual aids which you feel are inadequate or misplaced. (Specify)

2. List any titles which should be added to the audio-visual list.

3. List any demonstrations and/or laboratory exercises which proved unsatisfactory. Please explain.

4. What additional demonstrations and laboratory exercises should be added to this unit? Please describe or submit draft.

5. Which worksheet should be deleted or changed?

6. What additional worksheets should be added to this unit? Please describe or submit draft.

7. Other suggestions.

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Unit Eight

ENERGY AND MACHINES

2 - 3 WEEKS

FORCE, MOTION AND ENERGY

Chapter 17

LEARNING OBJECTIVES:

To develop an understanding of Newton's laws of motion.

To gain facility in doing quantitative problems involving work, energy and power.

TEXT REFERENCES:

Herron and Palmer, pages 277-286.

Herron and Palmer, Teacher's Guide, pages 84-88

Brooks, et. al., pages 182-187, 194-209, 224-226, 229-232.

RESOURCE MATERIALS:

Joseph, et. al., Teaching High School Science: A Sourcebook for the Physical Sciences, Harcourt, Brace and World, Inc., 1961.

AUDIO-VISUAL MATERIALS:

Films, Part I:

Forces, Copy B	13 min.	color	I or J
Laws of Motion	11 min.	b & w	S - J
Inertia of Motion	12 min.	b & w	I
Inertia of Rest	12 min.	b & w	I
Force	12 min.	b & w	I

Part II:

Work, Time and Power	14 min.	color	J
Gravity: How It Affects Us	14 min.	color	I - J
What is Uniform Motion?	13 min.	color	I or J
Energy and Work, Copy B	11 min.	color	I or J
Gravity	10 min.	b & w	J - I

Filmstrips:

Fs 530	Energy: Today and Tomorrow	S
Fs 530.1	Energy	I or J
Fs 530.1	Gravity	I or J
Fs 530.1	World's Energy Supply	J
Fs 531	What is Horsepower?	J - I

INSCHOOL MATERIALS:

Acceleration Apparatus, Physics

Force Table, Physics

Moment of Inertia Apparatus, Physics

Collision Balls Apparatus (Nonstock COL-4000), Physics

Friction Box (Nonstock FRI-0200), Physics

Guinea and Feather Tube (Nonstock GUI-5000), Physics

Halls Car (Nonstock HAL-5000), Physics

Inertia Apparatus (Nonstock INE-8000), Physics

Leaning Tower, Center of Gravity Apparatus (Nonstock LEA-3000), Physics

Ballistics Car, Physics

Dynamics Carts, Physics

Brick Weights, Physics

Boyle's Law Apparatus

Gas Laws Apparatus, Physics

Stool, Rotating, Physics

Weights, Physics

Composition of Forces Apparatus (Nonstock COM-3050), Physics

Second Law of Motion Apparatus (Nonstock SEC-5000), Physics

Gyroscope

CLASSROOM ACTIVITIES:

Recommended Laboratory Exercise: Force, Acceleration, Velocity and Momentum, see Appendix page 286.

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 85-87.

2. Discuss the difference between applying a force and doing work.

3. Develop the formula for measuring work: W = F x S. A small d may be used for distance if students have difficulty reconciling the letter S with the word distance.

4. Discuss reasons why car accidents are more frequent and disastrous at high speeds.

5. What problems have to be solved in order for a bomb to be dropped on a target?

6. Discuss some ways in which we use centrifugal force.

7. Discuss how kinetic energy may be changed to potential energy and vice versa. Do we use potential energy or must we change it first to kinetic energy?

Activities Suggestions:

1. Use the guinea and feather tube to demonstrate that the acceleration due to gravity is the same for all matter, but air resistance slows down low density materials.

2. Make a chart showing how much a person would weigh on the moon and various planets. Does the change in weight affect the mass of the person?

3. Demonstrate the importance of the placement of center of gravity using the leaning tower.

4. Use the second law of motion apparatus to demonstrate that acceleration downward is independent of forward horizontal motion.

5. Use the moment of inertia apparatus to demonstrate the dependence of the moment of inertia upon the distribution of mass.

6. Use the ballistic car to demonstrate that the horizontal component of velocity is independent of an applied vertical velocity.

WE WORK WITH MACHINES

Chapter 18

LEARNING OBJECTIVES:

To become aware of the basic definition, uses, and limitations of machines.

To be able to recognize different types of machines and also to see similarities between machines.

To learn how to determine the mechanical advantage of each different type of machine.

To see how the concepts of force and energy apply to fluids.

TEXT REFERENCES:

Herron and Palmer, pages 287-307

Herron and Palmer, Teacher's Guide, pages 88-95

Brooks, et. al., pages 187-194, 222-223

RESOURCE MATERIALS:

Joseph, et. al., *Teaching High School Science: A Sourcebook for the Physical Sciences*, Harcourt, Brace and World, Inc., 1961

AUDIO-VISUAL MATERIALS:

Films, Part I

Balancing Forces	14 min.	color	I - J
Moving Things on Land	11 min.	color	I - J
Machines Do Work	11 min.	b & w	I - J
Simple Machines	4 min.	b & w	I - J

Part II

Simple Machines: The Lever Family.	14 min.	color	I
Wheel and Axle and Pulley	8 min.	b & w	J - I
Lever and the Pulley	6 min.	b & w	J - I
Lever-Age	20 min.	b & w	J - S

Part III

Inclined Plane, Wedge and Screw	12 min.	b & w	I

Part IV

Lift	13 min.	b & w	J thru A
Drag	15 min.	b & w	J thru A
Aircraft and How They Fly	10 min.	b & w	J - S
Theory of Flight	12 min.	b & w	J - S
Stability and Controls	19 min.	b & w	J thru A
Problems of Flight	12 min.	b & w	J - S
Air in Action	10 min.	color	S - J

See audio-visual catalog for more listings.

Filmstrips:

Fs 531.4	Reducing Friction on Land	I thru A
Fs 531.4	Work and Friction	I - J
Fs 531.8	Inclined Planes at Work	I - J
Fs 531.8	Levers	I or J
Fs 531.8	Pulleys Make Work Easier	J - I
Fs 531.8	Screws and Wedges at Work	I - J
Fs 531.8	Wheels and Axles at Work	I - J
Fs 533.6	Overcoming Gravity	I thru A
Fs 629.132	How is an Airplane Controlled?	I or J
Fs 629.132	Jet Age Flight	I thru A
Fs 629.134	What Makes an Airplane Fly?	I or J
Fs 629.1343	How Do Jets Fly?	I or J

INSCHOOL MATERIALS:

Pulley, Differential, Chain Hoist, Physics

Inclined Plane, Adjustable Height, Physics

Gyroscope, Bicycle Wheel Type, Physics

Gyroscope, Simple Form (Nonstock GUI-5000), Physics

Halls Car (Nonstock HAL-5000), Physics

Jackscrew Model (Nonstock JAC-5000), Physics

Manometer (Nonstock MAN-4000), Physics

Pulleys, Bakelite (Nonstock PUL-4001, 2, 3, 12, 13), Physics

Pump, aspirator (Nonstock PUM-5000), Physics

Wheel and axle apparatus (Nonstock WHE-1000), Physics

Weights, Physics

CLASSROOM ACTIVITIES:

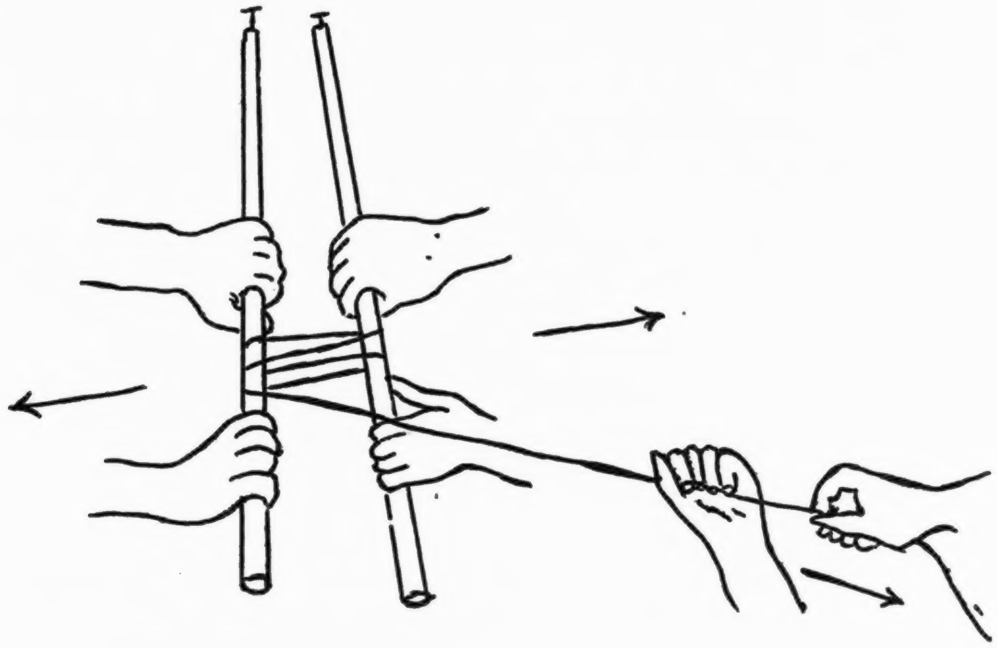
Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 89-93.
2. Review conservation of energy. Show that output cannot exceed input. Show that a machine must be efficient for the use to which it is applied.
3. What is the relation of friction to efficiency? What methods are used to reduce friction and improve efficiency?
4. Discuss the statement of Archimedes, "Give me a place to stand on and I will move the Earth."
5. Compare the advantages and disadvantages of using belts, gears and chains in machines.
6. Relate gears to the inclined plane and the wheel and axle.
7. Relate the mechanism of muscles and bones to levers. The mechanics of the forearm and biceps is a good example.
8. Discuss the teeth, needles, pins, knives, and axes as examples of wedges.
9. Discuss how the wheel and axle acts as a lever with the wheel acting as the long arm and the axle as the short arm.
10. What methods, in plane construction, are used to reduce drag?
11. Why is the ratio of wing surface of a jet fighter less than that of propeller-driven aircraft of the same weight?

12. Compare the flight of airplanes and rockets. How are rockets guided or controlled?

Activities Suggestions:

1. Wrap some clothesline around two window poles as shown in the diagram. Have the two strongest pupils in the class hold the window poles, as shown, and try to prevent the smallest girl student in the class from pulling them together. Students should conclude that the smaller student was using a machine to multiply her efforts.

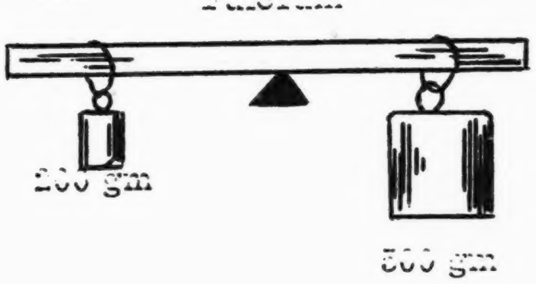


2. Compare the amount of force needed to overcome friction in moving an object across a surface as compared to lifting it. The illustration on page 291 in Herron and Palmer shows this. Use the Friction Box or a smooth wood block.

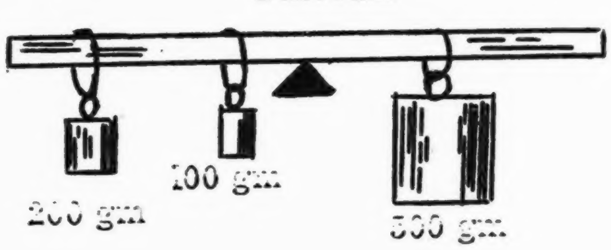
3. Use the Hall's Car to demonstrate the advantage of rolling friction rather than sliding friction.

4. Set up a meter stick on the knife-edge balance and experiment by using hooked weights to show that the clockwise moments equal counterclockwise moments when a state of equilibrium is reached. The The moment of a force is equal to force x level arm.

A

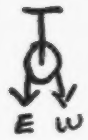


B

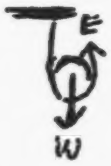


5. Demonstrate how the law of moments for parallel forces applies to laboratory balances.

6. Show that a gain in force is at the expense of distance, using a lever or single and double pulleys.



7. Demonstrate that a single fixed pulley changes direction, but no force is gained. Relate this to a first-class lever with fulcrum at the center.



8. Demonstrate that a single movable pulley may double the force but cut the speed in half. Relate this to the second-class lever with the load in the center.

9. Have students list applications of pulleys, gears, etc. where force is gained -- where speed is gained.

10. Try to give students the opportunity to feel the mechanical advantage of a rope block and tackle and a sizeable weight. Such equipment should be available in the physics room.

11. Measure and compare the "pitch" of several screws.

12. Have a student report on construction methods used in building pyramids.

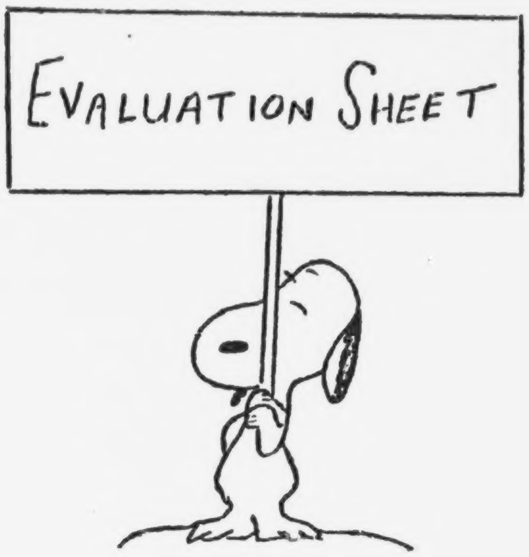
13. Some students may give reports on history, performance, etc. of different types of aircraft.

14. Have students complete a chart in which simple machines are identified in various compound machines. The chart below may suggest a form.

Compound machine	Screw	Lever	Pulley	Wheel & Axle	Inclined Plane	Wedge
Jackscrew						
Egg beater						
Pliers						
Hammer						
Scissors						
Saw						
Knife						
Set of gears						
Wrench						
Vise						
Water faucet						

Teachers' Evaluation of
of
Course Guide

UNIT NO. 8 *



1. List the title of any visual aids which you feel are inadequate or misplaced. (Specify)

2. List any titles which should be added to the audio-visual list.

3. List any demonstrations and/or laboratory exercises which proved unsatisfactory. Please explain.

4. What additional demonstrations and laboratory exercises should be added to this unit? Please describe or submit draft.

5. Which worksheet should be deleted or changed?

6. What additional worksheets should be added to this unit? Please describe or submit draft.

7. Other suggestions.

*Please fill out this form on the completion of each unit. Completed forms should be sent to the Science Specialist, Room 2041, Education Center at the end of each semester during the school year 1966-67.

Unit Nine

HEAT ENERGY

2 - 3 WEEKS

HEAT AND TEMPERATURE

Chapter 19

LEARNING OBJECTIVES:

To become familiar with the modern theory of heat.

To learn to use the Celsius and Fahrenheit temperature scales.

To gain practice in comparing the heat capacities of different substances.

To understand the effects of heat on the expansion and contraction of substances and on their change of state.

To understand the molecular explanation of evaporation.

TEXT REFERENCES:

Herron and Palmer, pages 309-324.

Herron and Palmer, Teacher's Guide, pages 95-100.

Brooks, et al., pages 248-262.

RESOURCE MATERIALS:

Joseph, et. al., Teaching High School Science: A Sourcebook for the Physical Sciences, Harcourt, Brace and World Inc., 1961.

AUDIO-VISUAL MATERIALS:

Films, Part I:

Learning about Heat	8 min.	b & w	I - S
Kinetic-Molecular Theory	9 min.	color	S thru A
Part II:			
Heat as Radiant Energy	13 min.	color	S - C
Measuring Temperature	11 min.	b & w	I - J
Part III:			
Things Expand When Heated	11 min.	b & w	S - J
Temperature and Matter	15 min.	color	J - S
Effects of Heat	15 min.	color	S - C
Ice	12 min.	b & w	I

Filmstrips:

Fs 936	Cause and Nature of Heat	J
Fs 936	Temperature	S
Fs 936	Measurement of Heat	S
Fs 936	Fusion	S
Fs 936	Gas Expansion	S
Fs 936	Heat Expansion	S
Fs 936	Vaporization	S
Fs 936.41	How Heat Causes Expansion	J
Fs 536	Refrigeration	S

INSCHOOL MATERIALS:

Ice Bombs (Nonstock ICE-1100), Physics

Compound Bar (bimetallic strip) (Nonstock COM-4000), Physics

Expansion Rods (Nonstock EXP-0500, 5, 10), Physics

Ball and Ring Apparatus (Nonstock BAS-0200), Physics

Pulse (Palm) Glass (Nonstock PUL-5000), Physics

Thermometer (Stock 29-T-2900 or 15), Physics or Chem

CLASSROOM ACTIVITIES:

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 95-98.
2. Discuss the fact that temperature is not a measure of the total heat possessed by an object, i.e., a cup of boiling water does not contain as much heat as a gallon of lukewarm water.
3. Discuss the heat content of water as a solid, a liquid and as a gas, and how we make use of this in cooling and heating.
4. Discuss need for allowing for expansion in construction of bridges, highways, railroads, building, etc.
5. Discuss the calorie and British Thermal Unit (B.T.U.)
6. Why is a knowledge of the behavior of metals at extremely high and low temperatures important in space travel?

Activities Suggestions:

1. Use the ball and ring apparatus, thermal expansion bar, and palm glass to show the expansion of solids and gases when heated.

2. Introduce the terms "heat of fusion" and of "heat of vaporization" and work out some problems for students showing the quantity of heat of energy that is absorbed in melting and boiling. Relate this to the operation of a refrigerator.

3. Have a student report on projects involving the use of solar heat.

4. Have students report on refrigeration, materials and methods used in house insulation, air conditioning, automobile engine cooling, steam heating, radiant heating, etc.

5. Have a student contact a highway or structural engineer to get information on the allowances for expansion and contraction in building highways, bridges and other structures.

6. Use the Thermometer Problem Sheet to show how the temperature scales were developed and to show the relationships between the various scales. See Appendix page 238.

7. Basic Biology teachers have some thermometer blanks which may be used to further explain the temperature scales.

HEAT TRANSFER AND USE Chapter 20

LEARNING OBJECTIVES:

To understand the methods of heat transfer and how they are applied.

To learn what things are necessary for a fire so that fires may be controlled.

To become familiar with the similarities and differences in heat engines.

TEXT REFERENCES:

Herron and Palmer, pages 325-345

Herron and Palmer, Teacher's Guide, pages 100-105

Brooks, et. al., pages 263-266, 90-93, 232-247

RESOURCE MATERIALS:

Joseph, et al., Teaching High School Science: A Sourcebook for the Physical Sciences, Harcourt, Brace and World, Inc., 1961.

AUDIO-VISUAL MATERIALS:

Films, Part I:

Nature of Heat	10 min.	color	S - J
Transfer of Heat	10 min.	b & w	S - J
Heat Conduction	12 min.	b & w	I

Part II:

Heat Conduction	12 min.	b & w	I

Part III:

Fire	10 min.	b & w	I - J
Combustion	15 min.	color	S thru A
Design for Disaster	27 min.	color	S
Planned Escape from Fire	11 min.	color	I thru A

Part IV:

Steam Engine	10 min.	b & w	J - I

Part IV, cont.:

Steam Turbine	8 min.	b & w	J - I
Diesel Story	20 min.	b & w	J thru A
Gas Turbine: The Story of the Engine that Revolutionized Flight	15 min.	b & w	J thru A
Conversion of Heat into Useful Work	15 min.	color	S - C
ABC of Internal Combustion	23 min.	color	S
Steam Age -- History of Transportation	20 min.	color	S thru A
Development of Transportation, 2nd ed.	11 min.	color	I - J

Filmstrips:

Fs 536	How Heat is Transferred	I - J
Fs 536	How Heat Travels	S
Fs 536	Story of Lighting and Heating	I - J
Fs 536	Putting Heat to Work	S
Fs 536	Internal Combustion Engine	S
Fs 541.36	Methods of Starting a Fire	I - J
Fs 541.36	Science and Fire	I - J
Fs 621	Getting Power from Engines	S
Fs 621	What Makes Engines Run?	S
Fs 629.1	Transportation, Copy D	J
Fs 614.84	Controlling Fire	I thru A

INSCHOOL MATERIALS:

Conductometer, Heat, 4-element (Nonstock CON-0220), Physics

Radiometer (Nonstock RAD-100), Physics

Fire Syringe, Physics

Thermometer (Stock 29-T-2900 or 15), Physics or Chem

CLASSROOM ACTIVITIES:

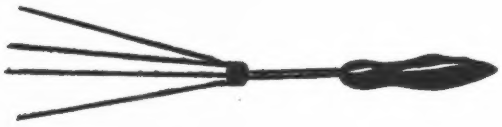
Recommended Laboratory Exercise: Heat Production and Transfer, see Appendix page 290.

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 100-102.
2. Have students campare radiation, convection and conduction of heat in terms of molecular motion and substances in which they occur. The insulating properties of a thermos bottle can be used as a good example.
3. Compare heat loss prevention by conduction, convection and radiation in the refrigerator, thermos, hot-water heating system, hot water heater and house.
4. Discuss the efficiency of a fireplace for heating.
5. Discuss conditions when chaparral fires in lecal canyons are most dangerous and likely.
6. Discuss fire prevention in the home and conditions around the home that may be conducive to fires.
7. Discuss methods of extinguishing fires. Exhibit the fire extinguisher, fire blankets, etc. Reviewing the section of the Handbook for Science Laboratory Practices and Safety pertaining to fires is appropriate.
8. Disucss why steam engines are inefficient, yet are considered to be economically sound to operate.

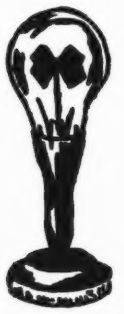
Activities Suggestions:

1. Demonstrate heat conduction in different metals by using the conductometer with marbles of identical sizes stuck to each arm with wax and heating apparatus in the flame of a bunsen burner.



2. Demonstrate convection in water by using the demonstration on page 326, Herron and Palmer. Potassium permanganate is just as effective as sawdust.
3. Demonstrate the radiometer. Be sure that the students note the direction it is turning in relation to the surfaces of the blades.

Explain in terms of molecular collisions and Newton's Third Law of Motion.



4. Set up thermometers at various places (near ceiling, floor, front, back, near doors, windows) in the room. Discuss the variations.

5. Use model steam and gas engines to show the differences and similarities. Show how force must change direction in order to make the engine operate. What simple machine principles are involved in these compound machines?

6. If the school auto shop has a cut-away model of an automobile engine use it to demonstrate parts and functions of an internal combustion engine.

Teachers' Evaluation of
of
Course Guide

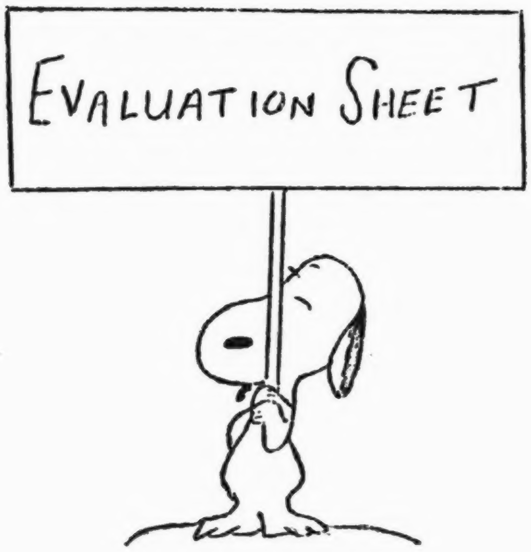
UNIT NO. 9 *

1. List the title of any visual aids which you feel are inadequate or misplaced. (Specify)

2. List any titles which should be added to the audio-visual list.

3. List any demonstrations and/or laboratory exercises which proved unsatisfactory. Please explain.

4. What additional demonstrations and laboratory exercises should be added to this unit? Please describe or submit draft.



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6. What additional worksheets should be added to this unit? Please describe or submit draft.

7. Other suggestions.

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Unit Ten

WAVE ENERGY

3-4 WEEKS

SOUND Chapter 21

LEARNING OBJECTIVES:

To understand the nature and characteristics of waves.

To learn what sound is.

To see how the physical nature of sound waves influences what we hear.

To gain some knowledge of the production of sound by musical instruments.

TEXT REFERENCES:

Herron and Palmer, pages 347-368

Herron and Palmer, Teacher's Guide, pages 105-113

Brooks, et. al., pages 282-306

RESOURCE MATERIALS:

Joseph, et. al., *Teaching High School Science: A Sourcebook for the Physical Sciences*, Harcourt, Brace and World, Inc., 1961.

Speech Synthesis Kit, Bell Telephone Company

AUDIO-VISUAL MATERIALS:

Films, Part I:

Waves and Energy	11 min.	color	I or J
Nature of Sound	11 min.	b & w	S - J
Sound Waves and Their Sources	10 min.	b & w	S

Part II:

What is Sound?	11 min.	b & w	J
Vibrations	13 min.	color	I or J
Ultra-Sound	10 min.	b & w	S - J
Sounds All About Us	11 min.	b & w	I - J
Sound Waves	15 min.	b & w	S

Part III:

Blind as a Bat	7 min.	color	I thru A
Ears and Hearing	11 min.	b & w	S - J
How the Ear Functions	11 min.	b & w	S - J
How We Hear	11 min.	b & w	S - J

Part IV:

Sounds of Music	10 min.	b & w	J - S
Looking at Sound	10 min.	b & w	J or S
Hearing the Orchestra	13 min.	b & w	J or S

Filmstrips:

Fs 534	Cause and Nature of Sound	J
Fs 534	Speaking and Hearing	J
Fs 534.2	How Sound Travels	J
Fs 612.85	You and Your Eyes	I - J
Fs 612.85	Your Ears and Hearing	I thru A

Soundstrips:

Ss 612.85	Our Wonderful Ears	I - J
Ss 612.78	Human Communication	I or J

Records:

Rec 534	Science of Sound	I thru A
Rec 534	Sound Patterns	J thru A
Rec 534	Strange to Your Ears	J or S

Tape:

Tape 534	Science of Sound (same as record above)	I thru A

Studyprints:

SP-L 612.85	How We Learn	
SP-L 612.85	Sectional Diagram of the Human Ear	S - J
SP-O 612.85	Ear	J or S

INSCHOOL MATERIALS:

Spring, Spiral Wave Motion Demonstration (Nonstock SPR-4100), Physics

Tuning Forks, Physics

Buzzer in Vacuo (Nonstock BUZ-6000), Physics

Siren Disc (Nonstock SIR-1000), Physics

Tuning Forks, Sympathetic, Physics

Organ pipe, Physics

Ripple Tank (Nonstock RIP-2010), Physics

Model, Anatomical, Ear, Biology

Oscilloscope, Physics

Oscillator, Audio, Physics

Resonance Tube, Physics

CLASSROOM ACTIVITIES:

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 106-111.
2. Discuss "frequency" as it applies to sound. What other kinds of frequencies can you mention.
3. Discuss what causes the amplitude of sound.
4. Discuss the effect of temperature upon sound vibrations, and why this happens.
5. What are sympathetic vibrations? Demonstrate with sympathetic tuning forks or with a tuning fork and piano.
6. Discuss the factors that control the pitch of a string on a violin or harp.

7. Discuss the work of an acoustical engineer. What is the importance of acoustics?

8. Discuss the Doppler Effect and its cause and applications.

9. Review the parts of the ear and discuss the function of each part. Emphasize the dangers to ears due to blows and infections.

10. Discuss hearing as one of the five senses which help protect us from potential dangers and otherwise keep us in contact with our environment.

11. Discuss the range of human hearing as compared to, for example, dogs and cats.

Activities Suggestions:

1. Use the *spiral spring* (wave motion demonstration) to demonstrate *transverse* and *longitudinal* waves. See text pages 348 and 351 respectively for techniques.

2. Demonstrate various tuning forks. Place the tips of the prongs of a vibrating tuning fork in a beaker of water to illustrate vibrations.

3. The audio oscillator, oscilloscope and a phonograph amplifier and speaker may be hooked up to demonstrate visually and audially the change in pitch with the change in frequency. The upper and lower frequency thresholds may be determined by experimentation. A microphone may also be used in place of the audio oscillator to show the wave patterns and sound frequencies of students' voices or musical instruments. Use the record "Science of Sound" from the A-V Center in conjunction with the apparatus.

4. Demonstrate the relationship between frequency and pitch by using the siren disc as illustrated on page 358 of text.

5. Use a *sonometer* or stringed instrument to show that the frequency increases and the pitch becomes higher as the vibrating string is shortened and also when its tension is increased.

6. Have students complete the worksheet *Human Ear* and discuss. See Appendix page 240.

7. Use the *buzzer in vacuo* apparatus to demonstrate that sound does not travel through a vacuum.

8. Have students put their ears to the table tops to observe the conduction of sound through solids.

9. Have students report on various hearing defects and hearing aids.

10. Let a student use the model or a chart of an ear to explain how sounds are perceived.

11. Have students report on the uses of hypersonics and ultrasonics.

12. Have students report on sonar and radar.

13. Have a student report on the research on sound being conducted at the Naval Electronics Laboratory.

THE NATURE OF LIGHT

Chapter 22

LEARNING OBJECTIVES:

To develop an appreciation of the modern wave-particle theory of light.

To understand how the physical characteristics of light influence its behavior.

To gain some facility in determining the intensity of illumination.

TEXT REFERENCES:

Herron and Palmer, pages 369-386

Herron and Palmer, Teacher's Guide, pages 113-118

Brooks, et. al., pages 307-316, 331-341

RESOURCE MATERIALS:

Joseph, et. al., *Teaching High School Science: A Sourcebook for the Physical Sciences*, Harcourt, Brace and World, Inc., 1961

Energy from the Sun (kit), Bell Telephone Company

Crystals and Light (kit), Bell Telephone Company

The Color Tree (pamphlet), Interchemical Corporation

AUDIO-VISUAL MATERIALS:

Films, *Part I*:

How Man Made Day	10 min.	color	I - J
Story of Light	10 min.	color	J thru A

Part II:

Light: Illumination and Its Measurement	14 min.	color	J - S
Motion and Time	11 min.	color	J - A
Light and Color	13 min.	color	I or J
Nature of Color	10 min.	color	S - J
Taking the X Out of X-rays	10 min.	b & w	S - J

Part II, cont:

Colour	15 min.	color	S - C
Discovering Color	13 min.	color	I or J

Filmstrips:

Fs 535	Light and Heat	J
Fs 535.6	Light and Color	J
Fs 535.6	What is Color	I thru A

INSCHOOL MATERIALS:

Chart of Electromagnetic Radiations, Physics

Chart, Electromagnetic Radiation (Nonstock CHA-3000), Physics

Chart, Spectrum (Nonstock CHA-3060), Physics

Color Disk (Nonstock COL-5000), Physics

Radiometer (Nonstock RAD-1000), Physics

Spectrum Tubes (Nonstock SPE-2000, 5, 10), Physics

Diffraction and Interference Kit (Nonstock DIF-2010), Physics

Photometer (Nonstock PHO-5000), Physics

Polaroid Experimental Kit, Physics

Spectrometer, Prism and Grating, Physics

Spectrometer, Grating, Physics

Rotator, Hand Operated, Physics

Rotator, Variable Speed, Physics

Illuminator, Optical Disc, Physics

Resonance Tube, Sodium, Physics

Stroboscope Kit, Physics

Newton's Rings Apparatus (Nonstock NEW-0800), Physics

Color Mixing Apparatus, Physics

Photometer, Photoelectric, Pocket Type, Physics

CLASSROOM ACTIVITIES:

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 113-116.
2. Compare light and sound as to velocity; how each is produced and transmitted. Compute the time necessary for the light from the sun to reach the earth.
3. Discuss what causes objects to appear to have color.
4. Discuss the length of light rays as they are separated by a prism.
5. Discuss the use of color and light in retail stores to make their products more attractive. Have students carefully observe lighting especially around clothing sales areas.
6. Discuss polarized light and the characteristics of light that make it possible to limit the plane of vibration.
7. Discuss the role of the photoelectric cell in sound movies. Secure samples of film so that students may see the sound track, as well as the pictures. Discuss how the electric current in a sound projector becomes sound waves.

Activities Suggestions:

1. Set up a ripple tank to demonstrate wave phenomena.
2. Have an interested student report on how the speed of light is measured.
3. Let a student demonstrate a photometer and explain how it works. Another student might demonstrate a lightmeter.
4. Have students make a survey of the lighting in their homes and make recommendations for improvements.
5. Use the cathode ray tube to demonstrate fluorescence.
6. Use the hand rotating apparatus or variable speed rotator to demonstrate the mixing or blending of colors.
7. Use the bioscope with polarizer to demonstrate polarization of light.
8. Use the spectrum tubes and diffraction gratings (physics) to show bright light spectra.
9. Have selected students use a "crystals and light" kit from Bell System Laboratories to study light and then report on this study.
10. A lighting engineer can be invited to explain the principles involved in proper lighting. He can also discuss some of the problems being studied in research laboratories today.

CHANGING THE DIRECTION OF LIGHT Chapter 23

LEARNING OBJECTIVES:

To see what happens when light is reflected.

To observe what happens when light is bent as it passes through a transparent lens.

To become aware of how the eye transmits light signals to the brain.

TEXT REFERENCES:

Herron and Palmer, pages 387-401

Herron and Palmer, Teacher's Guide, pages 118-123

Brooks, et. al., pages 316-331

RESOURCE MATERIALS:

Joseph, et. al., *Teaching High School Science: A Sourcebook for the Physical Sciences*, Harcourt, Brace and World, Inc., 1961

AUDIO-VISUAL MATERIALS:

Films, Part I:

Lenses	10 min.	b & w	S
Light Reflection	14 min.	color	J - S
Spherical Mirrors	8 min.	b & w	S
Shadows and Eclipses--Reflection	8 min.	b & w	S

Part II:

Refraction	8 min.	b & w	S
How to Bend Light	11 min.	color	I or J
Light: Refraction	14 min.	color	J - S
Light: Lenses and Optical Instruments	14 min.	color	J - S

Part III:

Light Waves and Their Uses	12 min.	b & w	S - J
Eyes and Their Care	11 min.	b & w	S - J

Part III, cont:

Eyes and Vision	10 min.	color	I thru A
Eyes: Their Structure and Care	11 min.	color	J - S
Your Eyes	10 min.	b & w	I - J

Filmstrips:

Fs 535.32	Light and How It Travels	J
Fs 612.84	Helping People to See	J - S
Fs 612.84	How We See and Hear	I - J
Fs 612.84	You and Your Eyes	I - J
Fs 612.84	Your Eyes	I thru A

Studyprints:

SP-O 612.84	Eye, Adnexa and Visual Tract	J or S

INSCHOOL MATERIALS:

Prism and Glass, Equilateral (Stock 29-P-6900), Physics

Anatomical Model, Eye, Biology or Physiology

Lenses, Physics

Lens Holder (Nonstock LEN-7300 or 10), Physics

Lucite Rod, Coiled (Nonstock LUC-0800), Physics

Mirror, Concave and Convex (Nonstock MIR-7000), Physics

Pinhole Camera (Nonstock PIN-1000), Physics

Refractor Plate (Nonstock REF-7000), Physics

Screen, Optical Bench, Physics

Mirror, Spherical (Nonstock MIR-8000), Physics

Optical Disk, Physics

CLASSROOM ACTIVITIES:

Recommended Laboratory Exercise: The Eye and Vision, See Appendix page 294.

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 118-121.

2. Discuss the fact that the rays bend toward the perpendicular when going from a less dense medium to one that is more dense.

3. Compare reflection of light from plane, concave and convex mirrors.

4. Compare regular reflection and diffusion of light.

5. Discuss the practices that will help maintain good eyesight.

6. Discuss the anatomy of the eye, using charts and the anatomical model.

Activities Suggestions:

1. Demonstrate the principal focus of a convex lens using the sun's rays as a source. Special attention may be drawn to the heat concentration.

2. Refraction can be easily demonstrated with a beaker of water or an aquarium and a pencil or rod. Show refraction of a light beam by shining on the surface of a beaker of soapy water.

3. Focus a parallel beam of light from a bright light source or filmstrip projector to demonstrate the effect of lenses on the light that passes through them. Hold a convex lens near the screen and move it slowly away until the focal point is observed on the screen. Repeat this using convex lenses with different focal length, each time noting the distance from the screen. Observe the results of similar experiments using concave lenses. The glasses of students may then be studied. Students will easily be able to tell if the student is nearsighted or farsighted and if there are significant differences between their eyes. This affords a good opportunity to emphasize the need for eye examinations and for wearing the glasses which may have been prescribed.

4. Borrow an eye-testing chart from the school nurse and let the students check their vision.

5. Have students complete the worksheet Human Eye and discuss. See Appendix page 241.

6. Have students report on eye defects and their correction, e.g., glaucoma, cataracts, nearsightedness, farsightedness, astigmatism, crossed eyes.

7. Using a set of color blindness charts, have a report on color blindness.

8. Dissect a sheep's eye for showing the anatomical structure.

9. Demonstrate internal reflection using the coiled lucite rod.

Teachers' Evaluation of
of
Course Guide

UNIT NO. 10 *

1. List the title of any visual aids which you feel are inadequate or misplaced. (Specify)

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2. List any titles which should be added to the audio-visual list.

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3. List any demonstrations and/or laboratory exercises which proved unsatisfactory. Please explain.

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4. What additional demonstrations and laboratory exercises should be added to this unit? Please describe or submit draft.

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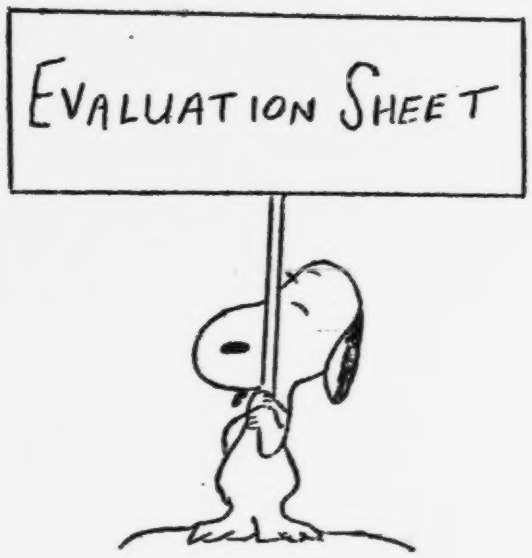

5. Which worksheet should be deleted or changed?

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6. What additional worksheets should be added to this unit? Please describe or submit draft.

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7. Other suggestions.

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*Please fill out this form on the completion of each unit. Completed forms should be sent to the Science Specialist, Room 2041, Education Center at the end of each semester during the school year 1966-67.

3

Unit Eleven

ELECTRICAL ENERGY

1 - 2 WEEKS

STATIC ELECTRICITY Chapter 24

LEARNING OBJECTIVES:

To become familiar with the laws governing the interaction between electric charges.

To gain facility in charging bodies with electricity by different means.

To appreciate the effects of static electricity in nature.

TEXT REFERENCES:

Herron and Palmer, pages 403-414

Herron and Palmer, Teacher's Guide, pages 123-127

Brooks, et al., pages 380-391

RESOURCE MATERIALS:

Joseph, et al., *Teaching High School Science: A Sourcebook for the Physical Sciences*, Harcourt, Brace and World, Inc., 1961

AUDIO-VISUAL MATERIALS:

Films, Part I:

Mighty Atom	18 min.	color	I - J
Electrostatics. 2nd Edition	11 min.		S - C
Static	12 min.	b & w	I
Coulomb's Law	28 min.	b & w	S

Part II:

Thunderbolt Hunters	11 min.	b & w	I thru A
Thunder and Lightning	11 min.	b & w	I

Filmstrips:

Fs 537	Electricity	J - I
Fs 537.2	Electricity. Copy C	J
Fs 537	Friction and Electricity	I - J
Fs 537.2	What is Static Electricity	I - J

Study Prints:

SP-S 621.3	Charles Steinmetz--He Defended Us from the Lightning	

Transparencies:

Trns - 537	Electricity	I thru A

INSCHOOL MATERIALS:

Electrophorus, Physics

Electroscope, Physics

Induction Spheres, Physics

Pith Balls (Stock 29-B-0200), Physics

Rod, Glass (Stock 29-R-5700), Physics

Rod, Hard Rubber (Stock 29-R-5705), Physics

Catskin, Friction Pad (Nonstock CAT-6000), Physics

Generator, Van de Graff, Physics

Electrostatic Plume (Nonstock ELE-4060), Physics

Electrostatic Whirl (Nonstock ELE-5000), Physics

Pad, Exciting, Silk (Nonstock PAD-0500), Physics

Pad, Exciting, Wool (Nonstock PAD-0510), Physics

Induction Coil, Physics

Dosimeters, Physics

CLASSROOM ACTIVITIES:

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 124-126.
2. Discuss the role of the electron in electrons when an object is changed electrostatically.
3. Discuss how lightning occurs.
4. Discuss procedures to follow if caught in an electrical storm.
5. What conditions usually prevail when a person receives "shocks" when entering or exiting from an automobile?
6. Discuss the uses made of static electricity in industry and science.

Activities Suggestions:

1. Materials are available to show each of the demonstrations illustrated in chapter 24 of the text.
2. A charged glass or rubber rod, or a pocket comb that has been charged by running through the hair may be used to attract a thin stream of water from a faucet.
3. Use the Van de Graff generator to demonstrate effects of static electricity. Use the electrostatic plume to demonstrate the repulsion of similarly charged bodies, and the electrostatic whirl to demonstrate the expulsion of charges from a point.
4. Student reports:

   Precautions against Static Electricity in Gasoline Tank Trucks.

   Precautions against Static Electricity in Grain Storage Elevators.

   Precautions against Static Electricity in Factories.

   Problems of Static Electricity in Space Flight.

   Use of Lightning Rods.

   Applications of Electrostatics in Smoke Control.

   Applications of Electrostatics in the Printing Industry.

CURRENT ELECTRICITY

LEARNING OBJECTIVES:

To become aware of the effects of an electric current.

To understand how current, potential difference, and resistance are related.

To learn to calculate resistances in simple circuits.

To become familiar with the production of electricity by chemical means.

To see how electricity can produce chemical changes.

TEXT REFERENCES:

Herron and Palmer, pages 415-426

Herron and Palmer, Teacher's Guide, pages 127-132

Brooks, et al., pages 344-358

RESOURCE MATERIALS:

Joseph, et al., Teaching High School Science: A Sourcebook for the Physical Sciences, Harcourt, Brace and World, Inc., 1961

AUDIO-VISUAL MATERIALS:

Films, Part I:

Basic Electricity	20 min.	color	S
Flow of Electricity	10 min.	b & w	S - J
Measurement of Electricity	10 min.	b & w	S - J
Principles of Electricity	20 min.	color	S
What Is Electric Current	13 min.	color	I or J
Electrician	12 min.	b & w	J or S
Electricity: Wires in Your Home	11 min.	color	I - J

Part II:

Story of the Modern Storage Battery	25 min.	color	J thru A
Primary Cell	11 min.	b & w	S
Introduction to Electricity	10 min.	color	I - J

Filmstrips:

Fs 537	Michael Faraday	I or J
Fs 537.6	What Is Current Electricity	I - J
Fs 621.328	Using Electricity Safely	I - J
Fs 621.35	Producing Small Amounts of Electricity	I - J

Study Prints:

Trns 537	Electricity	I thru A

INSCHOOL MATERIALS:

Ammeter, Physics

Crookes Tube, Physics

Galvanometer, Physics

Power Supply units, Physics

Induction Coil, Physics

Voltmeter, Physics

Cell, Voltaic (Nonstock CEL-4000), Chem or Physics

Resistance Spools, Physics

Resistance Box or Board, Physics

Rheostat, Physics

Wheatstone Bridge, Physics

Cell, voltaic, demonstration type (Nonstock CEL-4000), Physics

Thermoelectric Pair (Nonstock THE-0900), Physics

CLASSROOM ACTIVITIES:

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 128-131.

2. Discuss insulators and conductors and the uses of each.

3. Explore the production of heat by electricity such as in toasters, irons and heaters as a function of the resistance of the elements and the flow of current. Why does the heating element get hot while the appliance cord remains cool?

4. Distinguish between an alternating current and a direct current. Give examples of each.

5. Discuss factors to consider in buying an automobile battery. Be sure to include discussion of the results of interchanging 6-volt and 12-volt batteries from one auto to the other, or using "jump wires" from one automobile to another when the batteries have different voltages. Discuss the difference between a battery that is discharged (dead) due to use or an external short circuit and a battery that is old and worn out due to internal shorting. Discuss the use of a hydrometer for testing the state of charge of a battery.

Activities Suggestions:

1. Have students demonstrate circuits in parallel and in series.

2. Set up several problems for students to calculate resistance, "pressure" and quantity of current using Ohm's Law.

3. Dissect worn-out dry cell and storage batteries and discuss how they work.

4. Small currents can be detected from a very simple cell consisting of a dime (silver) and a penny imbedded in a citrus fruit. Use a galvanometer to measure the current.

5. Use a thermocouple (thermoelectric pair) attached to a galvanometer to demonstrate direct transformation of heat energy to electrical energy. The galvanometer, to prevent damaging it due to its extreme sensitivity, should always be used very cautiously and by the direction of someone experienced in its use.

6. Use the demonstration voltaic cell to show the varying voltages due to different combinations of electrodes.

7. Demonstrate the use of the voltmeter, ammeter and wheatstone bridge in making electrical measurements.

8. Have students trace the circuit of a flashlight or other simple battery-operated device so they will be able to recognize the parts that apply to any electrical circuit - the batteries (and terminals of the batteries), conductor (battery case), switch and appliance (bulb).

MAGNETISM AND ELECTRICITY

Chapter 26

LEARNING OBJECTIVES:

To become familiar with the magnetic properties of materials.

To see how magnetism and electricity are related.

To understand how alternating currents are produced and used.

TEXT REFERENCES:

Herron and Palmer, pages 427-445

Herron and Palmer, Teacher's Guide, pages 132-138

Brooks, et. al., pages 358-379

RESOURCE MATERIALS:

Joseph, et. al., Teaching High School Science: A Sourcebook for the Physical Sciences, Harcourt, Brace and World, Inc., 1961

AUDIO-VISUAL MATERIALS:

Films, Part I:

Magnetic, Electric and Gravitational Fields	11 min.	color	I or J
Magnetism, Copy B	13 min.	b & w	I or J
Van Allen Radiation Belts	17 min.	color	J - S

Part II:

Basic DC Meter Movement	3 min.	b & w	J - S
How an Electric Motor Works	12 min.	color	J
Light and Power	22 min.	b & w	I - J
Electromagnets: How they Work	11 min.	color	I - J

Part III:

How to Produce Electric Current with Magnets	11 min.	color	I - J
Energy in Our Rivers	10 min.	color	I - J

Part III, cont:

Watch Power	12 min.	b & w	S - J
Electricity: From Power Plant to Home	12 min.	b & w	J - I
Freedom and Power	20 min.	color	J thru A
Copper Network	22 min.	color	J - S

See audio-visual catalog for more listings.

Filmstrips:

Fs 538.7	Earth's Magnetism	I or J
Fs 537	Electric Magnets	J
Fs 538	Electromagnets and How They Work	I - J
Fs 621.31	How Electricity is Produced	I - J
Fs 621.31	Thomas Alva Edison	I - J
Fs 621.32	Thomas Alva Edison. Copy B	I - J
Fs 621.32	Wizard of Menlo Park	I - J
Fs 643.6	Home Electrical Appliances	J or S
Fs 643.6	How Is Electricity Used in the Home?	I - J

Transparencies:

Trns 537	Electricity	I thru A

Study Prints:

SP-S 621.3	Thomas Edison--He Couldn't Let Well Enough Alone	I - J
SP-L 621.31	Power Generation	I thru A
SP-S 538	Magnetism	I - J
SP-S 621.32	Thomas Alva Edison	J or S
SP-L 621.32	Thomas Edison and Electricity	I thru A

INSCHOOL MATERIALS:

- Motor, Electric, St. Louis, *Physics*
- Generator and Motor, Demonstration, *Physics*
- Induction Coil, *Physics*
- Primary and Secondary Coil set, *Physics*
- Transformer, Variable Voltage, *Physics*
- Transformer, Dissectible, Demonstration, *Physics*
- Voltmeter, *Physics*
- Magnets, *Physics*
- Tangent Galvanometer (Nonstock TAN-1200), *Physics*
- Compass, Magnetic (Stock 29-C-5800 or 15), *Physics*
- Crookes Tube, *Physics*
- Galvanometer, *Physics*
- Thermo-Electric Magnet, *Physics*
- Induction Study Outfit (Nonstock IND-8500), *Physics*
- Magnets, Breaking (Nonstock MAG-4005), *Physics*
- Magnet, Floating (Nonstock MAG-4010), *Physics*
- Magnetic Needle (Nonstock MAG-4060), *Physics*
- Magnetic Needle, Dipping (Nonstock MAG-4065), *Physics*

CLASSROOM ACTIVITIES:

Recommended Laboratory Exercise: *Electricity and Magnetism*, see Appendix page 297.

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 132-136.
2. Discuss the relationship between electrical power and electrical energy.
3. Discuss watts, kilowatts, how electric power is measured and how electric bills are measured. Have the students find out the cost of electricity per kilowatt hour and determine how long they can operate a particular appliance for 25¢.

4. Discuss the danger and inconvenience of overloading a circuit. Students should be able to perform the calculations necessary to determine total current in a circuit as shown on page 442 of the text.

5. Discuss what substances can become magnetized and how this is done; make a class list of substances which can be magnetized. Discuss induced and natural magnets. What is a lodestone?

6. Discuss the advantages of electricity as a power source. Why do we have AC in our homes rather than DC?

7. Discuss ways in which we use electrical energy to produce heat, sound, light, mechanical and chemical energy.

8. Discuss short circuits - their causes, danger and prevention. Have the class survey their homes for potential short circuits.

9. Discuss factors to consider when wiring a home for electrical power.

10. Discuss the function and purpose of fuses and circuit breakers. Obtain as many kinds as possible and emphasize their importance for safety in the use of electricity.

11. Discuss the disadvantage of many electrical appliances in that they produce a considerable amount of heat when their purpose may be to produce light or mechanical energy. Use the film projector as a case in point.

12. Discuss printed circuits, their uses, production, advantages and disadvantages.

13. Discuss the production and transmission of electricity from generator to consumer.

Activities Suggestions:

1. Use the overhead projector to demonstrate types of magnets, using an acetate over the magnet and sprinkle iron filings over the acetate to illustrate magnetic fields. Do not do this prior to the laboratory exercise.

2. Have students obtain information from the San Diego Gas and Electric Company regarding their various plants including the nuclear powered plant at San Onofre.

3. Demonstrate the production of electricity by induction by attaching a coil of wire to an ammeter or galvanometer and thrusting a bar magnet quickly through the coil. Note the relationship between: direction and amount of deflection, motion and polarity of the magnet, and speed of motion.

4. Use the Demonstration Generator and Motor to show the principles involved and to emphasize the similarities between two such devices.

5. Use the hand generator with lamp to demonstrate transformation of mechanical to electrical energy. Note the effect of speed of rotation on brightness and frequency of flashes. Relate this to voltage and AC frequency.

6. Set up the electric motor to demonstrate how magnetism is used to make electric motors operate.

7. Have students guess how many electrical appliances they have in their homes, and then make a list of them to determine a more exact number. Have them then list the form of energy into which each device changes the electricity.

8. Have a student report on neon and fluorescent lights, giving the origin, principle and efficiency of each.

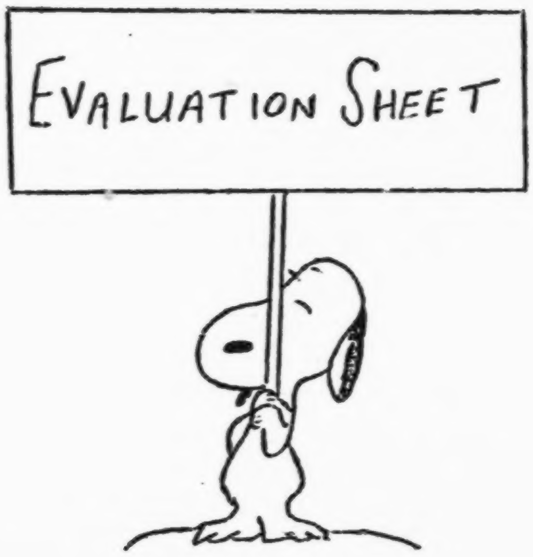
9. Student reports can include solar batteries, coils, transformers, generators, automobile ignition system, etc.

10. Demonstrate the dipping magnetic needle to indicate the vertical component of the magnetic lines of force.

11. Have students demonstrate to the students:
    (1) how to unplug an appliance from a wall outlet properly;
    (2) how to replace a plug on the end of a cord;
    (3) how to dismantle a lamp socket to replace a cord or assess a malfunction.

Teachers' Evaluation of
of
Course Guide

UNIT NO. 11 *



1. List the title of any visual aids which you feel are inadequate or misplaced. (Specify)

2. List any titles which should be added to the audio-visual list.

3. List any demonstrations and/or laboratory exercises which proved unsatisfactory. Please explain.

4. What additional demonstrations and laboratory exercises should be added to this unit? Please describe or submit draft.

5. Which worksheet should be deleted or changed?

6. What additional worksheets should be added to this unit? Please describe or submit draft.

7. Other suggestions.

*Please fill out this form on the completion of each unit. Completed forms should be sent to the Science Specialist, Room 2041, Education Center at the end of each semester during the school year 1966-67.

Unit Twelve

ELECTRONICS

1 - 2 WEEKS

COMMUNICATION DEVICES

Chapter 27

LEARNING OBJECTIVES:

To become familiar with the means of sending messages over wires.

To understand how simple vacuum tubes operate.

To appreciate how messages are transmitted by means of electromagnetic waves.

TEXT REFERENCES:

Herron and Palmer, pages 447-465

Herron and Palmer, Teacher's Guide, pages 138-144

Brooks, et. al., pages 391-413

RESOURCE MATERIALS:

Joseph, et. al., Teaching High School Science: A Sourcebook for the Physical Sciences, Harcourt, Brace and World, Inc., 1961

Pacific Telephone (local office) will provide, upon request, class sets of the booklet, How the Telephone Works.

AUDIO-VISUAL MATERIALS:

Films, Part I:

Development of Communication. 2nd Edition	11 min.	b & w	J - I
Telegram for America	22 min.	b & w	I thru A
Mr. Bell	32 min.	b & w	I thru A
Telephone and Telegraph	10 min.	b & w	J or S
Western Crossing	11 min.	color	I thru A
Your Voice and the Telephone	8 min.	color	I thru A

Part II:

Vacumm Tubes: The Triode and the Multipurpose Tubes	14 min.	b & w	J thru A
Bottle of Magic (Electronic Tube)	14 min.	b & w	J thru A

Electrons at Work	14 min.	color	S - J
Demonstration with Light	14 min.	color	S - J

Part III:

Sound Recording and Reproduction	11 min.	b & w	S - J
On the Air	11 min.	b & w	J or S
On the Air! The Story of Radio Broadcasting	28 min.	b & w	I thru A
Stepping Along with Television	10 min.	b & w	I thru A
Telstar	27 min.	color	I thru A
Receiving Radio Messages (Principles of Radio)	11 min.	b & w	S - J

Filmstrips:

Fs 621.38	Electrical and Electronic	I or J
Fs 384	History of Communication	I thru A
Fs 384	Story of Communication Series	I thru A
Fs 621.38	Electronics: What Is It?	I - J
Fs 621.38	What Is Electronics	S - J
Fs 621.381	Calling Your Neighbor	J
Fs 621.3815	Electronic Tubes	I - J
Fs 621.3815	Transistors	I - J
Fs 621.382	Samuel Finley Breese Morse	I - J
Fs 621.384	Radio Waves	I - J
Fs 621.384	Receiving Antennas	S
Fs 621.384	Talking Through the Air	J - I
Fs 621.385	Alexander Graham Bell	I - J
Fs 621.388	Television Station and Its Services	I - J

Study Prints:

SP-M 384	Telephone Story Board	color	all gr.
SP-S 621.38	Communication--Radio and Television		I - J
SP-S 621.385	Communication--Development of Telegraph		I - J
SP-S 539	*Solid State Physics (Manual, 5 charts, 5 paper transparencies)		I thru A

*C.E.R. Kit which may be available from Physics

INSCHOOL MATERIAL:

Oscilloscope, Physics

Radio Outfit, Short Wave, Demonstration, Physics

Sounders, Telegraph (Nonstock SOU-4000), Physics

Relay, Pony Telegraph, Physics

Speaker, Electrovoice, Physics

Telephone Receiver (Nonstock TEL-0100), Physics

Telephone Transmitter (Nonstock TEL-0110), Physics

"Sun to Sound" Kit (Bell Laboratories), Physics

CLASSROOM ACTIVITIES:

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 139-142.
2. Discuss and, if possible, demonstrate frequency modulation and amplitude modulation.
3. Discuss San Diego as a center of manufacturing of electronics equipment. What factors have determined the location of such factories? e.g., manpower, market, expansion of previous ventures, etc.
4. Discuss the transformation which occurs as radio waves are converted to sound waves.
5. Discuss reasons for "static" on the car radio as you pass under a high-power line.

6. Compare radio waves to light waves.

7. Discuss the meaning of kilocycle and megacycle.

8. Discuss the operation of the oscilloscope and demonstrate its uses.

Activities Suggestions:

1. Demonstrate the telegraph key and sounder.

2. Show the class how a telephone set is constructed. Demonstration units are available in all science departments.

3. Invite a representative of the Pacific Telephone and Telegraph Company's Education Department to give a demonstration in your school.

4. Get an old loudspeaker and take it apart to show how it operates.

5. Oral or written reports can include transistors, radar and sonar; uses of radar on land, sea and in the air; how G.C.A. works.

6. Secure several types of discarded radio tubes. Remove the glass covering by carefully filing the glass where it joins the base. Attach tags or label the parts. Use for display or to pass around the class.

7. Explore the interests of the class for those who have hobbies and ability in this area. Invite such students to borrow demonstration or testing equipment from the school electric shop. Be sure to caution them to keep their explanations simple and direct so that less-informed students won't become confused.

8. Use the Demonstration Radio outfit to show the parts of a radio and their purposes.

AUTOMATION AND COMPUTERS Chapter 28

LEARNING OBJECTIVES:

To become aware of the uses of automation.

To discover the difference between the two basic types of computers.

To learn the principles by which computers operate.

TEXT REFERENCES:

Herron and Palmer, pages 466-479

Herron and Palmer, Teacher's Guide, pages 144-148

Brooks, et al., pages 413-414.

RESOURCE MATERIALS:

Joseph, et al., Teaching High School Science: A Sourcebook for the Physical Sciences, Harcourt, Brace and World, Inc., 1961

AUDIO-VISUAL MATERIALS:

Films, Part I:

Automation. Part I	33 min.	b & w	S thru A
Automation. Part II	22 min.	b & w	S thru A
Screen News Digest. Vol. 5 Issue 10	22 min.	b & w	J thru A

Part II:

Better Way!	30 min.	color	J thru A

Filmstrips:

Fs 658.561	Automation and Society	J - S
Fs 658.561	Automation: What Is It?	J - S
Fs 658.561	How Automation Affects Careers	J - S
Fs 658.561	Science and Automation	J - S

INSCHOOL MATERIALS:

Governor, Fly-ball type, Physics

Thermostat, Adjustable (Nonstock THE-4000), Physics

Record H EE S AW DHUH KAET (He Saw the Cat), (Bell Telephone Laboratories), Physics

CLASSROOM ACTIVITIES:

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 145-147.
2. Discuss the precision and speed of computers as compared to the work of men.
3. Discuss modern requirements of man for speed in computation, e.g. jet aircraft, rockets, space probes.
4. Discuss the microminiaturization of electronic equipment to meet present-day needs.
5. Discuss the possibility of producing a robot that may control man.
6. Discuss the advantages and disadvantages of the binary system in computers.

Activities Suggestions:

1. Have a student report on microminiaturization of electronic equipment.
2. Have students make a list of the automatic devices that are in their homes.
3. Have a student report on the use of automation for quality control in industry.
4. Demonstrate the use of the governor and gyroscope (Physics) as simple automatic controls.
5. Demonstrate the thermostat and discuss the many opportunities for its uses.
6. Use the Bell Laboratories record "He Saw the Cat" to demonstrate some of the possibilities of computers.

Teachers' Evaluation of
of
Course Guide

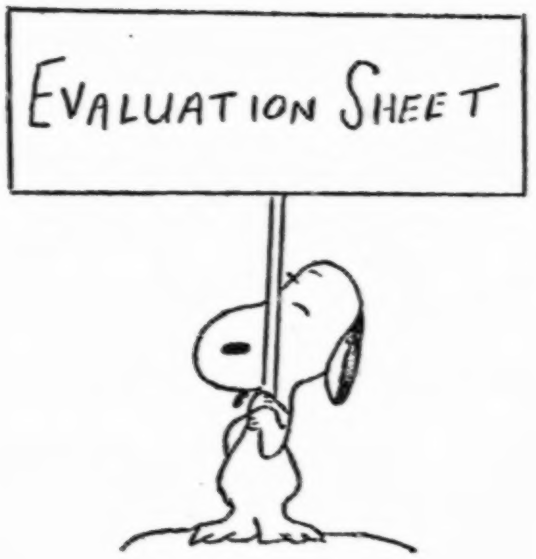
UNIT NO. 12 *

1. List the title of any visual aids which you feel are inadequate or misplaced. (Specify)

2. List any titles which should be added to the audio-visual list.

3. List any demonstrations and/or laboratory exercises which proved unsatisfactory. Please explain.

4. What additional demonstrations and laboratory exercises should be added to this unit? Please describe or submit draft.



5. Which worksheet should be deleted or changed?

6. What additional worksheets should be added to this unit? Please describe or submit draft.

7. Other suggestions.

*Please fill out this form on the completion of each unit. Completed forms should be sent to the Science Specialist, Room 2041, Education Center at the end of each semester during the school year 1966-67.

Unit Thirteen

NUCLEAR ENERGY

1 - 2 WEEKS

CHANGES WITHIN THE ATOM

Chapter 29

LEARNING OBJECTIVES:

To gain an understanding of natural radioactivity.

To develop an awareness of how man can detect nuclear events that he cannot observe with his own senses.

To find out how man can change atoms by fission or fusion.

To see what kind of order scientists have discovered among the basic particles of matter.

TEXT REFERENCES:

Herron and Palmer, pages 481-499

Herron and Palmer, Teacher's Guide, pages 149-155

Brooks, et. al., pages 418-432, 440-443

RESOURCE MATERIALS:

Joseph, et. al., Teaching High School Science: A Sourcebook for the Physical Sciences, Harcourt, Brace and World, Inc., 1961

AUDIO-VISUAL MATERIALS:

Films, Part I:

Atomic Energy--An Introduction	11 min.	b & w	S thru J
Strange Case of the Cosmic Rays Part I	30 min.	color	J thru A
Strange Case of the Cosmic Rays Part II	30 min.	color	J thru A
Radioactivity. Copy B	13 min.	color	J thru S

Part II:

Nuclear Disintegration	30 min.	b & w	S thru A
Atomic Furnaces	14 min.	b & w	S
Atomic Energy--Inside the Atom	13 min.	color	I or J
Our Friend the Atom. Part I	25 min.	color	J thru A

Part III:

Atomic Radiation	12 min.	b & w	S thru J
Unlocking the Atom--Nuclear Fission	20 min.	b & w	S thru J
A is for Atom	16 min.	color	J thru S

Filmstrips:

Fs 539.72	Exploring the Atom	J thru S
Fs 539.752	Bombarding the Nucleus	J thru S
Fs 539.752	Radioactive Transmutation and Half-life	J thru S
Fs 539.752	What is Radioactivity?	J thru S
Fs 539.76	Atom	S

Soundstrips:

Ss 539.76	Atomic Bomb (2 Rec, 1 Fs)	S thru J

Transparencies:

Trns 539.76	Atomic Series	I thru A

INSCHOOL MATERIALS:

Cloud Chamber, Physics

Radioactivity Demonstrator, "Classmaster", Physics

Scalar, Physics

CLASSROOM ACTIVITIES:

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 149-154.
2. Discuss the biological effects of radioactive radiation on living cells.
3. Emphasize that distance from and shielding from sources of radioactivity provide our only protection.
4. Discuss the reasons for many scientists in the 1880's and 1890's feeling that all of the major discoveries had been made and many things would remain unknown about atoms, atomic structure, etc.

5. Discuss the difference between fission and fusion.

6. Discuss the fusion process which produces the sun's energy.

Activities Suggestions:

1. Use the class master radiation detector to demonstrate the diminishing effects of radiation due to increasing distance and shielding. Test watch dials as sources of radioactivity.

2. Use the cloud chamber to demonstrate that the paths of radiations from radioactive materials can be made visible, enabling scientists to study them.

3. Have students report on the work of the Curies, Becquerel, Rutherford.

4. Have students report on devices used in atomic research--cyclotron, betatron, bubble chambers, cloud chamber, Van de Graff generator.

5. Show the effect of a radiation source on a charged electroscope to demonstrate the operation of a dosimeter.

6. Review the emergency procedures in case of atomic attack and discuss the reasoning behind the procedures.

NUCLEAR ENERGY

Chapter 30

LEARNING OBJECTIVES:

To understand how we use radiation counters to detect radioactivity.

To understand the effect of different amounts of radioactivity on the human body.

To see how uranium is used to produce energy in nuclear reactors.

To develop some knowledge of the uses of radioisotopes.

TEXT REFERENCES:

Herron and Palmer, pages 500-511

Herron and Palmer, Teacher's Guide, pages 155-158

Brooks, et al., pages 432-440, 443-444

Smith and Lisonbee, pages 430-433

RESOURCE MATERIALS:

Joseph, et. al., Teaching High School Science: A Sourcebook for the Physical Sciences, Harcourt, Brace and World, Inc., 1961

AUDIO-VISUAL MATERIALS:

Films, Part I:

Atom Goes to Sea	12 min.	b & w	J thru A
Atomic Power	18 min.	b & w	S thru J
Industrial Atom	14 min.	b & w	S
Petrified River. The Story of Uranium	28 min.	color	I thru A
Geiger--Mueller and Scintillation Counters (Laboratory)	30 min.	b & w	S thru A
Atomic Power Production	14 min.	color	J thru S

Part II:

Atomic Fingerprint	13 min.	color	S
Atomic Biology for Medicine	14 min.	b & w	S

Living with the Atom	26 min.	color	J thru A
Report on the Atom	20 min.	b & w	S thru J
Our Friend the Atom. Part II	25 min.	color	J thru A
Atom and Biological Science	12 min.	b & w	S thru J

Filmstrips:

Fs 621.48	Atoms As You Will Use Them	J
Fs 621.48	Our Friend the Atom	I thru A
Fs 539.76	Secret of Nuclear Energy	J thru S
Fs 539.76	Using Nuclear Energy	J thru S
Fs 541.38	Discovering Isotodes	J thru S
Fs 539.7	Atomic Energy	J
Fs 539.7	Atomic Energy for Better Health	J
Fs 539.76	Atoms for Peace	S
Fs 539.76	Nuclear Energy	S
Fs 539.76	Putting Atoms to Work	I thru J
Fs 541.38	Radioactive Isotopes	I thru J

Transparencies:

Trns 539.76	Atomic Series	I thru A

Study Prints:

SP-S 621.48	Peaceful Uses of Atomic Energy	I thru A

INSCHOOL MATERIALS:

CER Kit, Peaceful Uses of Atomic Energy, Physics

Civil Defense Radiation Kit

Dosimeters, Physics

CLASSROOM ACTIVITIES:

Discussion Suggestions:

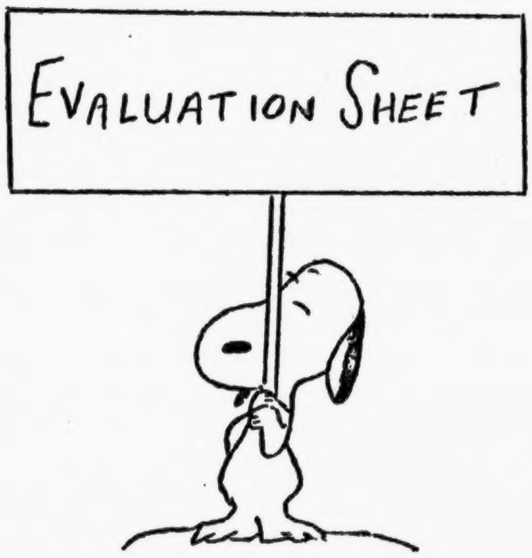
1. See Herron and Palmer, Teacher's Guide, pages 156-157.
2. Discuss the various devices for detecting radiation and the advantage of each kind.
3. Discuss tagged atoms and their uses in industry, agriculture and medicine.
4. Distinguish between isotopes and radioisotopes.
5. Why not use a nucelar reactor for power in automobiles?
6. Discuss use of radiocarbon dating of ancient objects and formations.

Activities Suggestions:

1. Use the materials in the Civil Defense Radiation Kit located in your school to show the various devices for radiation detection. These include battery powered monitoring devices and dosimeters.
2. Use the CER Kit, Peaceful Uses of Atomic Energy, which contains bulletin board materials and sound filmstrips, to further develop the discussions.
3. Have students report on uses of atomic energy for producing power. A special report on the San Diego Gas and Electric Company plant at San Onofre would be especially interesting.
4. Have students report on the use of nuclear reactors:
    (1) in producing radioisotopes and
    (2) breeder reactors.
5. Have students report on the kinds of work being done at General Atomic.

Teachers' Evaluation of
of
Course Guide

UNIT NO. 13 *



1. List the title of any visual aids which you feel are inadequate or misplaced. (Specify)

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6. What additional worksheets should be added to this unit? Please describe or submit draft.

7. Other suggestions.

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Unit Fourteen

THE EARTH IN SPACE

1-2 WEEKS

PLACE AND TIME

LEARNING OBJECTIVES:

To become aware that our common descriptions of time and place are arbitrary distinctions.

To learn what things can be used in finding direction or locating place.

To learn about the effects of rotation and revolution on the earth.

To become familiar with the characteristics of rotation and revolution of earth.

To understand our present system of keeping time.

TEXT REFERENCES:

Herron and Palmer, pages 515-524

Herron and Palmer, Teacher's Guide, pages 159-163

Brooks, et al., pages 537-542

RESOURCE MATERIALS:

Joseph, et al., Teaching High School Science: A Sourcebook for the Physical Sciences, Harcourt, Brace and World, Inc., 1961

American Geological Institute, Geology and Earth Science Sourcebook, Holt, Rinehart and Winston

AUDIO-VISUAL MATERIALS:

Films, Part I:

How We Know the Earth's Shape	11 min.	color	I or J
Latitude and Longitude	10 min.	b & w	J - I
Which Way Is North?	14 min.	b & w	I - J
Great Circle	14 min.	b & w	J - S

Part II:

How We Know the Earth Moves	11 min.	color	I or J
Shape of the Earth	29 min.	color	S thru A
Earth and the Sun's Rays and the Seasons	15 min.	b & w	J - I

Part II, cont:

Earth and the Sun's Ray: Distributor of Insulation	4 min.	b & w	J or I

Part III:

About Time: Part I	30 min.	color	I thru A
About Time: Part II	30 min.	color	I thru A
Mastery of Time	40 min.	color	I thru A
Story of Measuring Time: Hours, Minutes, Seconds	11 min.	color	I or J
Time	15 min.	color	J thru A
Time and Clocks	27 min.	b & w	S
Story of Time	9 min.	color	I thru A

Filmstrips:

Fs 525	Earth in Motion	S - J
Fs 525	Our Earth	I - J
Fs 525	Our Earth in Motion	I or J
Fs 525.3	Motions of the Earth in Space	J or S
Fs 525.5	Changing Seasons	J or S
Fs 525.1	Earth's Shape and Size	J or I

Telescope:

Questar, Call Mr. Mahoney, Instructional Aids Center, 298-4681, Ext.307

INSCHOOL MATERIALS:

Celestial Globe, Physics

Planetarium, Trippensee, Physics

Rotator, Variable speed, Physics
"Centrifugal" hoops, Physics
"Centrifugal force", unequal masses, Physics

World Globe

World Maps

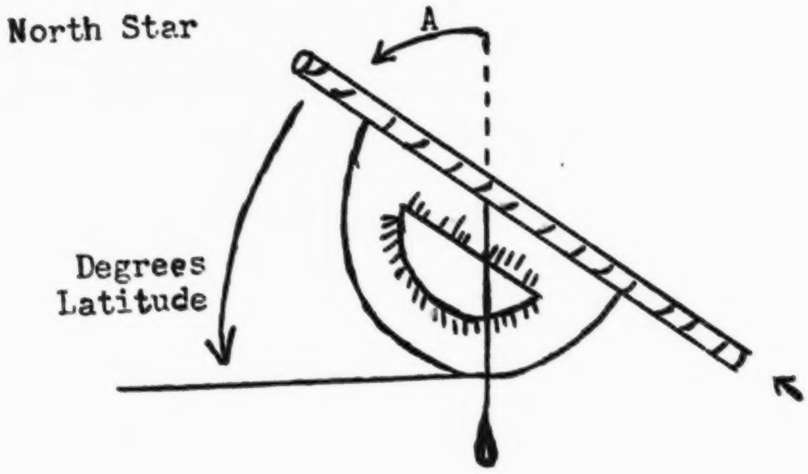
CLASSROOM ACTIVITIES:

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 160-162.
2. Discuss the difference between rotation and revolution, as used in astronomy.
3. Discuss the sort of seasons the earth would have if its axis were perpendicular to the plane of its orbit.
4. Discuss the origin of the zodiac and how superstitous people regard these symbols today.
5. Discuss a sundial and its accuracy in telling time.
6. Discuss the Foucault pendulum as a means of telling time.
7. Why is it useful for two nearby cities to be included in the same time zone. For example, what would be some of the consequences if San Diego and Los Angeles were in different time zones? Discuss the need for standard time zones.

Activities Suggestions:

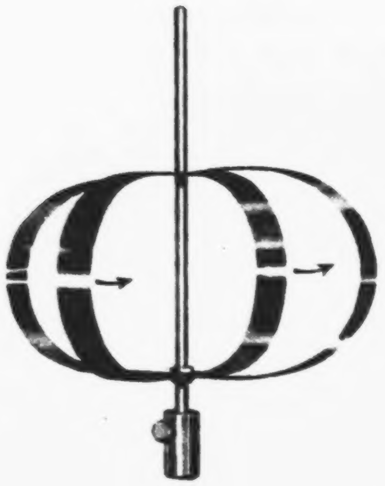
1. To make a simple quandrant, students can tape a protractor to a drinking straw, as illustrated, with a weighted thread at the center point. Sighting at the North Star will give the angle A; subtracted from 90 degrees, it will yield the latitude of your locality.



2. Help students understand the meaning and usefullness of latitude and longitude by locating cities or islands on a globe or map. You may read coordinates and have students see who can identify the location first. Discuss the value of being able to determine your coordinates at sea or in the air.
3. Use the Trippensee Planetarium to demonstrate the movements of the earth and moon around the sun. Discuss the limitations of this

model in simulating the relative motions of these three bodies.

4. The "centrifugal" hoop (illustrated), when rotated on an axis, flattens out. This action demonstrates the flattening of the earth at the poles. Ask a physics student to explain this phenomenon in terms of centripetal force.



5. Have a group of interested students plan an experiment to demonstrate that the angle of the sun's rays changes from day to day. Carry the experiment out for a month and have the students report the results to the class. If possible have the experiment repeated at another season of the year.

6. Fill two shallow boxes with sand. Lay a thermometer in each box with the bulb covered with sand. Place both boxes in the direct sunlight; one box at right angles to the suns's rays while the other is at a more oblique angle. Fifteen to thirty minutes later the difference in temperatures noted should illustrate how the angle of the sun's rays affect heat absorption.

THE EARTH, THE MOON AND THE SUN

Chapter 32

LEARNING OBJECTIVES:

To know that the sun is a star composed of superheated gases under immense pressure, whose energy is the product of a nuclear reaction.

To understand that the sun has its own organized composition, rotation and surface activity.

To learn the major kinds of surface features on the moon.

To understand why the moon shows phases.

To learn the causes of solar and lunar eclipses.

TEXT REFERENCES:

Herron and Palmer, pages 525-535

Herron and Palmer, Teacher's Guide, pages 163-166

Brooks, et al., pages 542-554

RESOURCE MATERIALS:

Joseph, et al., Teaching High School Science: A Sourcebook for the Physical Sciences, Harcourt, Brace and World, Inc., 1961

American Geological Institute, Geology and Earth Sciences Sourcebook, Holt, Rinehart and Winston

AUDIO-VISUAL MATERIALS:

Films, Part I:

Nearest Star	29 min.	color	S thru A
Our Mr. Sun. Part I	30 min.	color	I thru A
Our Mr. Sun. Part II	30 min.	color	I thru A
Our Star	11 min.	color	I thru A
Portrait of the Sun	19 min.	color	I or J
Sun	11 min.	b & w	J
Sun's Energy	17 min.	color	I thru A

Part II:

Trip to the Moon	16 min.	color	I thru A
This is the Moon	11 min.	b & w	J - I
Moon. Copy B	11 min.	b & w	J
Moon	11 min.	b & w	J - I
Exploring the Moon	16 min.	color	I thru A

Part III:

Sun, Earth and Moon	11 min.	b & w	J - I
Eclipse	11 min.	b & w	J - I
Ocean Tides: Bay of Fundy	14 min.	color	I thru A

See film catalog for additional listings.

Filmstrips:

Fs 523.3	Exploring the Moon	J - S
Fs 523.3	Man and the Moon	I thru A
Fs 523.3	Moon. Copy B	J or S
Fs 523.3	Silvery Moon	S - J
Fs 523.7	Exploring the Sun	J - S
Fs 523.7	Our Sun	I - J
Fs 523.7	The Sun	I - J
Fs 523.8	Our Sizzling Sun	S - J
Fs 523	Earth As a Planet	J or S

Slides:

523 2x2	Planets and Stars	I - J

Transparencies:

Trns 523	Astronomy	I thru A

Telescope:

Questar, Call Mr. Mahoney, Instructional Aids Center, 298-4681, Ext. 307

Study Prints:

SP-S 523.3	Moon (8 color)	I or J
SP-S 523.3	Through the Eyepiece: The Moon	I thru A
SP-L 523.3	Through the Eyepiece: The Moon	I thru A

INSCHOOL MATERIALS:

Celestial Globe, Physics

Planetarium, Trippensee, Physics

Rotator, Variable speed, Physics

Rotator Globe, Glass (Nonstock ROT-0050), Physics

CLASSROOM ACTIVITIES:

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 163-166.
2. Discuss conditions on the moon. Why do we only see one side of the moon?
3. Ask students to account for the fact that it takes 29½ days from full moon to full moon, while the actual period of revolution of the moon is 27 1/3 days.
4. Discuss "earthshine" and have students watch for it.
5. Discuss solar and lunar eclipses, and the phases of the moon during which they may occur.
6. What would be the effect on a total solar eclipse if the radius of the moon's orbit was reduced?
7. Discuss erosion of the cliffs along the coast by tide and wave action. Discuss the dangers of entering the caves sometimes produced.

Activities Suggestions:

1. The Questar may be used to view the sun, looking for sunspots. Be sure to use the sun filter and mask out the mirror for the viewfinder as described in the Handbook for Science Laboratory Practices and Safety.

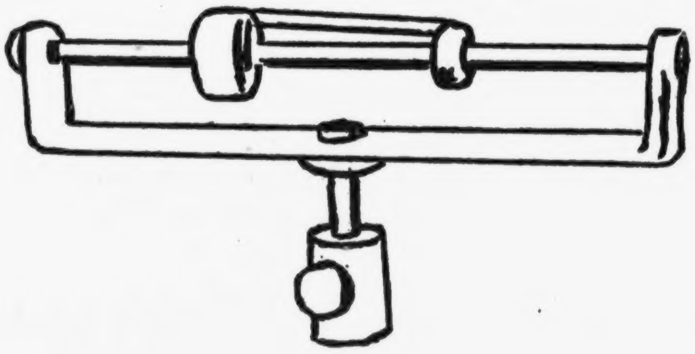
2. Have the pupils make a sketch of the appearance of the moon and its position in the sky each night for at least two weeks. Record the time of rising and setting from the newspaper. Using graph paper, have the students plot a graph using the horizontal axis for the date and the vertical axis for the time. Perhaps some students may wish to follow through with this for a lunar month. Also have students sketch and label various phases of the moon. The Trippensee Planetarium helps to show this.

3. Demonstrate why we see only one side of the moon; a tennis ball to represent the moon and a globe for the earth would be satisfactory. Put a mark or colored pin on the moon and keep it toward the earth as the moon is moved in its orbit. Be sure the class understands that the moon turns once on it axis as it travels once around the earth.

4. Review the nature of tides and discuss why high tides occur both toward and away from the moon. Each student should look in the newspaper for information on tides. Ask for reasons why the tide tables are important enough to be published.

5. Have students report on recent discoveries concerning the composition of the moon's surface.

6. Demonstrate rotation of moon and earth around a common center by using the rotator with the apparatus as shown:



The apparatus consists of one light and one heavy cylinder mounted free to slide along the rod and connected by a string as illustrated. If these are rotated when the axis of rotation is vertical, the cylinders will probably both fly to one end of the rod upon which they are mounted. If they are placed equally distant on each side of the axis of rotation, they will fly to the side with the larger cylinder due to its greater mass. If these cylinders are placed on the other side, they will fly to that end of the rod when rotating. By carefully placing them so that the two cylinders are on opposite sides of the axis with the larger cylinder near the center, they will rotate and hold this position. Similarly, the earth and the moon go around a point of rotation which is very close to the earth. This accounts for some of the irregular phenomena of the moon. If it were simply a matter of the moon going around the earth and the center of the earth being the center of rotation, the moon's period and position in the sky would be much more regular month by month. For more information refer to any standard Physics or Astronomy text.

7. Have students report on the use of tides for production of power.

8. Have students report on the destructive action of tides in the San Diego area during spring tides and indicate what is being done to minimize the destruction.

EVALUATION SHEET

Teachers' Evaluation of
of
Course Guide

UNIT NO. 14 *

1. List the title of any visual aids which you feel are inadequate or misplaced. (Specify)

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2. List any titles which should be added to the audio-visual list.

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3. List any demonstrations and/or laboratory exercises which proved unsatisfactory. Please explain.

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4. What additional demonstrations and laboratory exercises should be added to this unit? Please describe or submit draft.

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5. Which worksheet should be deleted or changed?

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6. What additional worksheets should be added to this unit? Please describe or submit draft.

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7. Other suggestions.

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*Please fill out this form on the completion of each unit. Completed forms should be sent to the Science Specialist, Room 2041, Education Center at the end of each semester during the school year 1966-67.

Unit Fifteen

ASTRONOMY AND ASTRONAUTICS

2 - 3 WEEKS

(Optional)

OUR SOLAR SYSTEM AND BEYOND

LEARNING OBJECTIVES:

To grasp the mechanical organization of the solar system, and to know the major types of bodies that make it up.

To be able to recall the most principal characteristics of the sun and individual planets.

To understand the differences among moons, planets, stars, constellations, galaxies and nebulas.

To realize the position and magnitude of the earth relative to the Milky Way Galaxy. To become acquainted with some of the principal tools astronomers use.

TEXT REFERENCES:

Herron and Palmer, pages 537-561

Herron and Palmer, Teacher's Guide, pages 167-176

Brooks, et al., pages 554-578

RESOURCE MATERIALS:

Joseph, et al., Teaching High School Science: A Sourcebook for the Physical Sciences, Harcourt, Brace and World, Inc., 1961

American Geological Institute, Geology and Earth Science Sourcebook, Holt, Rinehart and Winston

AUDIO-VISUAL MATERIALS:

Films, Part I:

Planets in Orbit (Laws of Kepler)	10 min.	b & w	J - S
Solar System	10 min.	b & w	J - I
Jupiter, Saturn and Mars in Motion	8 min.	color	I thru A
Mars and Beyond	30 min.	color	I thru A
World Is Born	20 min.	color	J or S
Space Science: The Planets	16 min.	color	J
Space Science: Comets, Meters and Planetoids	11 min.	color	J
Sun's Family	10 min.	b & w	J - I

Part II:

How Many Stars	11 min.	color	J
Understanding Our Universe	11 min.	color	I thru A
Universe	28 min.	b & w	I thru A
Constellations: Guides to the Night Sky	11 min.	color	J
Depths of Space	11 min.	b & w	J
Milky Way	11 min.	b & w	J
Stars and Star Systems	16 min.	b & w	J - S

Part III:

Story of Palomar	40 min.	color	S thru A
Light Sources and Their Spectra	30 min.	color	S thru A
Light Lenses and Optical Instruments	14 min.	color	J - S
Flaming Sky	29 min.	color	S thru A
Charting the Universe: With Optical and Radio Telescope	13 min.	color	J - S

See film catalog for additional listings.

Filmstrips:

Fs 523.4	Our Neighbors in Space	J
Fs 523.4	Planets and Comets	J - S
Fs 523.4	Life on Other Planets	S - J
Fs 523.4	Giant Planets: Jupiter, Saturn, Uranus and Neptune	I - J
Fs 522.2	Mount Wilson and Palomar Telescope	J - S
Fs 523	Astronomy	J
Fs 523	Laws of the Sky	S - J
Fs 523	Man Becomes an Astronomer	I thru A
Fs 523	Starry Universe	S

Fs 523	Time, Space and Energy	S - J
Fs 523.1	Milky Way and Other Galaxies	J - S
Fs 523.1	Nebulae	J - S
Fs 523.1	Universe and Space	J
Fs 523.89	Sky Patterns	S - J

Slides:

522.2 2x2	Palomar Telescope	I thru A
523 2x2	Planets and Stars	I - J

Transparencies:

Trns 523	Astronomy	I thru A

Telescope:

Questar, Call Mr. Mahoney, Instructional Aids Center, 298-4681, Ext. 307

Study Prints:

SP-S 523.2	Solar System	I or J

INSCHOOL MATERIALS:

Celestial Globe, Physics

Planetarium, Trippensee, Physics

Rotator, Variable Speed, Physics

Spectrum tubes (Nonstock SPE-2000, 5, 10), Physics

Rotator Globe (Nonstock ROT-0050), Physics

CLASSROOM ACTIVITIES:

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 168-174.
2. Discuss the dimensions of the solar system in terms of light-years.
3. Discuss the relationship between earth, solar system, galaxie and universe.
4. Discuss the contributions of Galileo and Copernicus to our knowledge of astronomy.

5. Discuss how planets can be distinguished from other heavenly bodies.

6. Discuss the asteroids with special emphasis on Ceres.

7. Point out that though the speed of light is very great, we may be seeing light from stars that no longer exist, light from new stars may not yet have reached us. Discuss the "light year" and the amazing distance involved.

Activities Suggestions:

1. Have students complete the following chart to decide if life on the other planets in the solar system is possible. The filmstrip, "Life On Other Planets," (Fs 523.4) may be helpful here.

Planet	Atmosphere	Water	Temperature	Do You Think Life Is Present?
Earth	Contains enough oxygen - no poison	Plenty	Range suitable for life	Yes

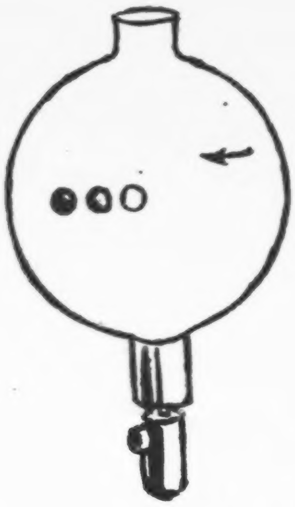
2. Have a student check an astronomy magazine to see which planets are presently visible and encourage students to look for them, if possible, with a telescope.

3. Have students make graphs which include the following information on each planet.

	DIAMETER (MILES)	PERIOD OF REVOLUTION (EARTH YEAR)	MEAN DISTANCE FROM SUN (MILLIONS OF MILES)	VELOCITY (MILES PER SEC.)
Mercury	3,100	.24	36	29.70
Venus	7,700	.55	67.1	21.70
Earth	7,927	1	92.9	18.47
Mars	4,200	1.88	142	15
Jupiter	88,000	11.86	483	8.10
Saturn	75,000	29.46	886	6
Uranus	30,000	84.02	1780	4
Neptune	30,000	164.79	2790	3.4
Pluto	3,600	248.4	3670	2.9

Discuss the factors that are closely related and those which seem completely dependent on the other. Have the student suggest what the velocity of the asteroids would be. You should be able to relate this to earth satellites in chapter 34. Use the demonstration below to show that the angular velocity is independent of mass.

4. Place three balls of the same size but different densities into the rotator globe. Rotate the globe about 200-300 RPM. The height to which the balls will rise up the slope of the globe is dependent upon angular velocity and the radius of the globe and is independent of mass. The three balls will take up positions at the same heights dependent upon the speed of the rotation. Care should be used in placing the balls in the globe. They should not be dropped through the opening at the top. A similar demonstration can be done using mercury and colored water. Relate this to the masses orbits and velocities of the asteroids.



5. Have students report on estimating distances in space.

6. The Doppler effect in the light of stars is presented by simple diagram and description, page 240 in Geology and Earth Sciences Sourcebook. Explain that the change in wave lengths due to going toward and away from a star is similar to the wave length change in sound as evidenced in the approach and receding sound of a train whistle at a crossing.

7. Show how it was possible to identify helium on the sun by using the spectrum tubes and diffraction gratings to demonstrate that each element produces a unique spectrum.

Student Reports: Theories of the Origin of the Universe
The Stellar Universe
Supernova
Supergalaxy
Spiral Nebula
Dwarf Star
Cepheid Variable
The Arms of the Galaxy (Sci. Am. Dec. '59)
Life Outside the Solar System (Sci. Am. Apr. '60)
Stellar Populations (Sci. Am. Nov. '58)
Evolution of Interstellar Material
Electronic Photography of Stars (Sci. Am. Mr. '56)
Clouds of Magellan (Sci. Am. Apr. '56)
The Significance of the Zodiac and the 12 Constellations In It

THE EXPLORATION OF SPACE

Chapter 34

LEARNING OBJECTIVES:

To understand the principle of launching satellites by multi-stage rockets.

To achieve an elementary understanding of the physical mechanics of a satellite orbit.

To become acquainted with the various useful functions a satellite or probe may have in space.

To appreciate the problems space scientists face with respect to reentry, vacuum conditions, acceleration, radiation, meteoroids and space medicine.

TEXT REFERENCES:

Herron and Palmer, pages 562-580

Herron and Palmer, Teacher's Guide, pages 176-183

Brooks, et al., pages 589-606

RESOURCE MATERIALS:

Joseph, et al., *Teaching High School Science: A Sourcebook for the Physical Sciences*, Harcourt, Brace and World, Inc., 1961

NASA Facts, A Periodical Educational Publication of the National Aeronautics and Space Administration will be mailed to addressees who request it from:

NASA, EDUCATIONAL PUBLICATIONS DISTRIBUTION CENTER
AFEE-1, Washington, D. C. 20546

AUDIO-VISUAL MATERIALS:

Films, Part I:

What is Space	10 min.	color	I or J
Atlas Project Film Report	8 min.	color	I thru A
Exploring Space	26 min.	color	I thru A
Rockets: How They Work	14 min.	color	I thru A
First Men in Space	16 min.	color	I - J
Man and the Moon	20 min.	color	I thru A

Part I, cont:

Man in Space	33 min.	color	I thru A
Mission: 22 Orbits	10 min.	b & w	All gr.
Satellites: Stepping Stones to Space	18 min.	color	I or J
Space Probes: Exploring Our Solar System	11 min.	color	J - S

Part II:

New Frontiers in Space	24 min.	b & w	S - J
On Target: Atlas I.C.B.M.	30 min.	color	I thru A
Explorers in Space	10 min.	b & w	I thru A
Exploring by Satellite	28 min.	color	J thru A
Science in Space	29 min.	color	S thru A
Earth Satellite--Explorers of Outer Space	17 min.	color	I thru A

See audio-visual catalog for additional listings.

Filmstrips:

Fs 629.1388	Aerospace	I or J
Fs 629.1388	Earth Satellite	I thru A
Fs 629.1388	Exploring the Moon	I or J
Fs 629.1388	Exploring the Space Around Earth	J or S
Fs 629.1388	Flight Around the Moon	I thru A
Fs 629.1388	Flight into Space	I thru A
Fs 629.1388	Flight to Mars	I thru A
Fs 629.1388	Man in Space	I thru A
Fs 629.1388	Information from Satellites	J or S
Fs 629.1388	New Frontiers in Space	J thru A
Fs 629.1388	Space Stations	I or J

Fs 629.1388	THOR Missile Story	I thru A
Fs 629.1388	Current Events in Space	I - J

Soundstrips:

Ss 629.1388	Medical Aspects of Space Flight	S thru A
Ss 629.1388	Teaching Children About Space Science	I - J
Ss 623.4519	From Drawing Board to Launching Pad	I thru A

Records:

Rec 629.1388	9:34 a.m., E.S.T., May 5, 1961. A recording of the Historic Space Flight of America's First Astronaut	I thru A
Rec 629.1388	Voice of the Satellites and Flight of the Astronaut	I thru A

INSCHOOL MATERIALS:

Celestial Globe, *Physics*

CLASSROOM ACTIVITIES

Discussion Suggestions:

1. See Herron and Palmer, Teacher's Guide, pages 176-182.
2. Discuss the latest theories of the origin of the universe.
3. Discuss the advantage of being able to take things into the vacuum of space, e.g., welding materials, production of vacuum tubes.
4. Discuss the different types of lunar probes: fly by, orbiter, impact, hovering, landing.
5. Discuss launching rocket toward the east to take advantage of the earth's rotation.
6. Discuss "escape velocity" of the earth and compare it to that of other planets.
7. Discuss the hours of optical tracking of satellites being restricted to dawn and dusk.
8. Discuss the large day-to-night fluctuation in temperatures that occur in space and on the moon and some other planets.

9. Discuss the meaning of g, 2g, 3g, etc. Relate that 2g means two times the acceleration resulting from the force of gravity: A person undergoing 2g appears to weigh twice as much as his own weight.

__Activities__ __Suggestions:__

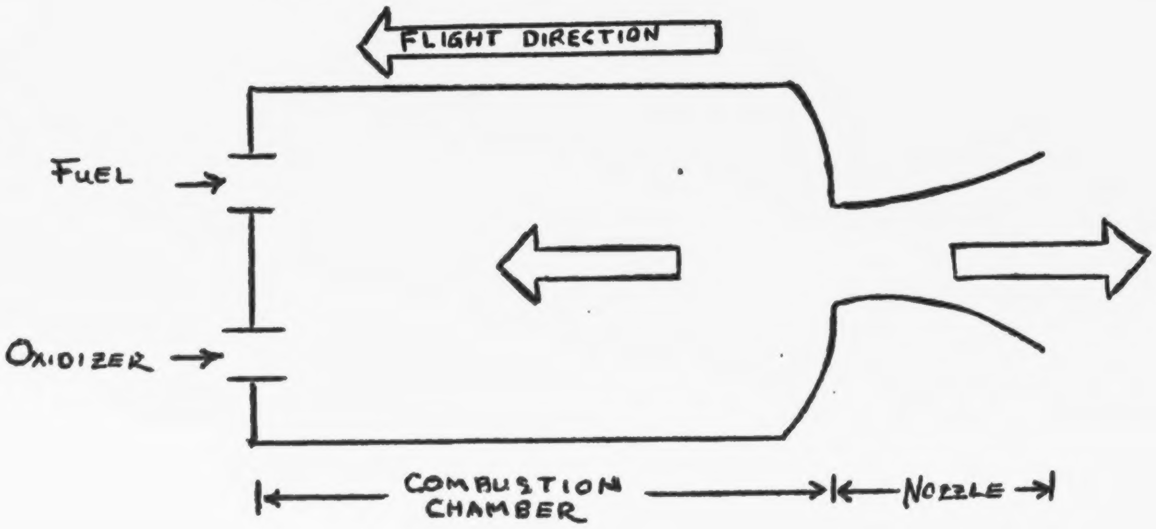
1. Collect information concerning some of the most significant space probes. Include date, country that launched the probe, primary mission and degree of success.

2. Have students determine the oxygen needs and speculate on the oxygen problems that a 6-man crew would encounter on a 23-day space probe. (An average man needs two pounds of oxygen per day.)

3. Have reports on methods of navigation in space.

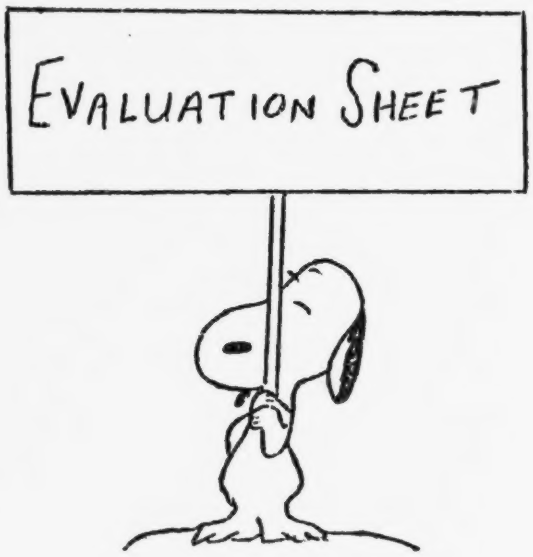
4. Have a student report on the radio tracking of satellites.

5. Using the diagram below, have students label and discuss typical parts of a rocket. Which arrow represents "Action" and which represents "Reaction"? The rocket is an application of Newton's Third Law of Motion.



Teachers' Evaluation of
of
Course Guide

UNIT NO. 15 *



1. List the title of any visual aids which you feel are inadequate or misplaced. (Specify)

2. List any titles which should be added to the audio-visual list.

3. List any demonstrations and/or laboratory exercises which proved unsatisfactory. Please explain.

4. What additional demonstrations and laboratory exercises should be added to this unit? Please describe or submit draft.

5. Which worksheet should be deleted or changed?

6. What additional worksheets should be added to this unit? Please describe or submit draft.

7. Other suggestions.

*Please fill out this form on the completion of each unit. Completed forms should be sent to the Science Specialist, Room 2041, Education Center at the end of each semester during the school year 1966-67.

APPENDIX

Appendix A	Maps and Charts
Appendix B	Worksheets
Appendix C	Laboratory Exercises

Appendix A: Maps and Charts Pages

Map of Greater San Diego Area 213

Map of San Diego County 214

Map of California 215

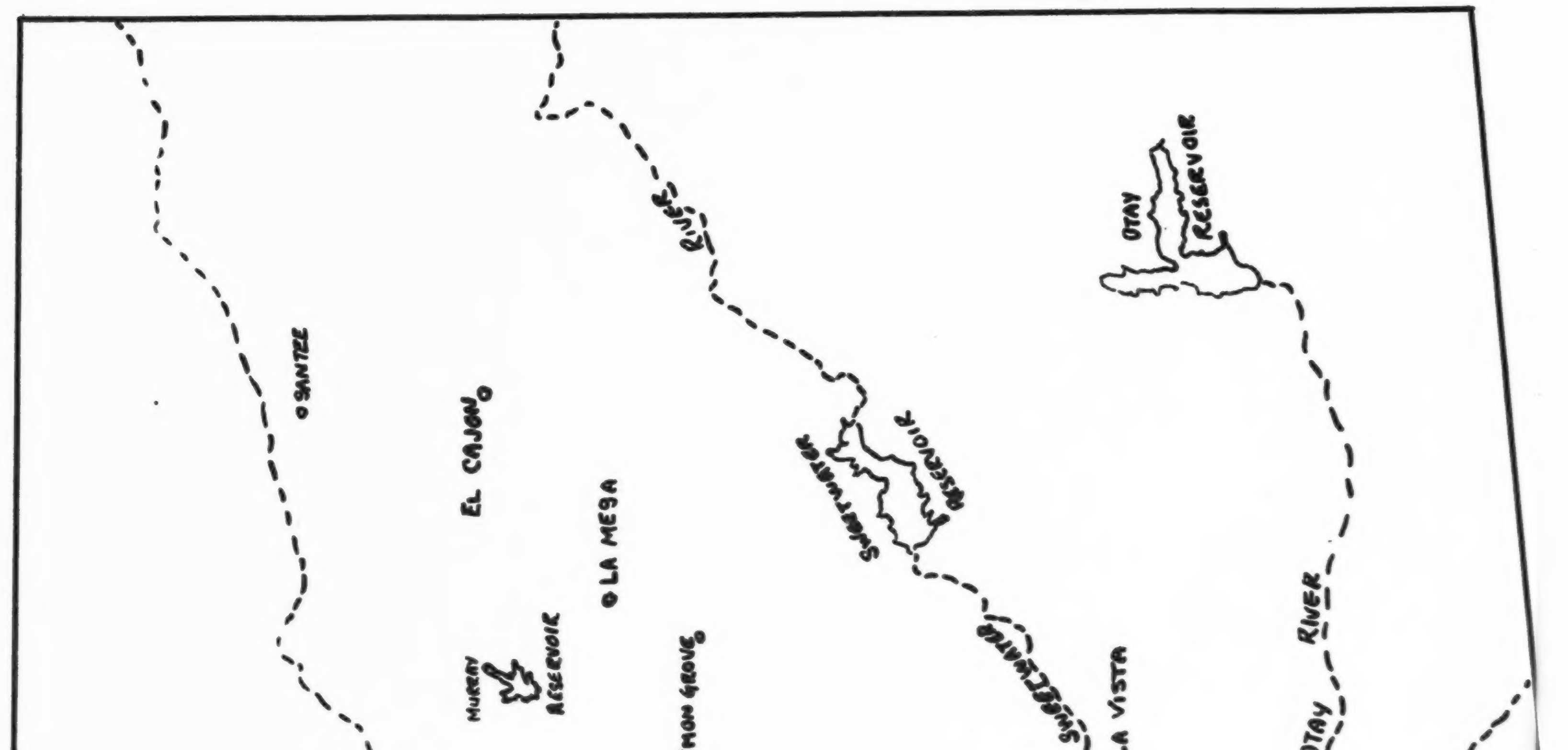
Map of United States. 216

United States Weather Map 217

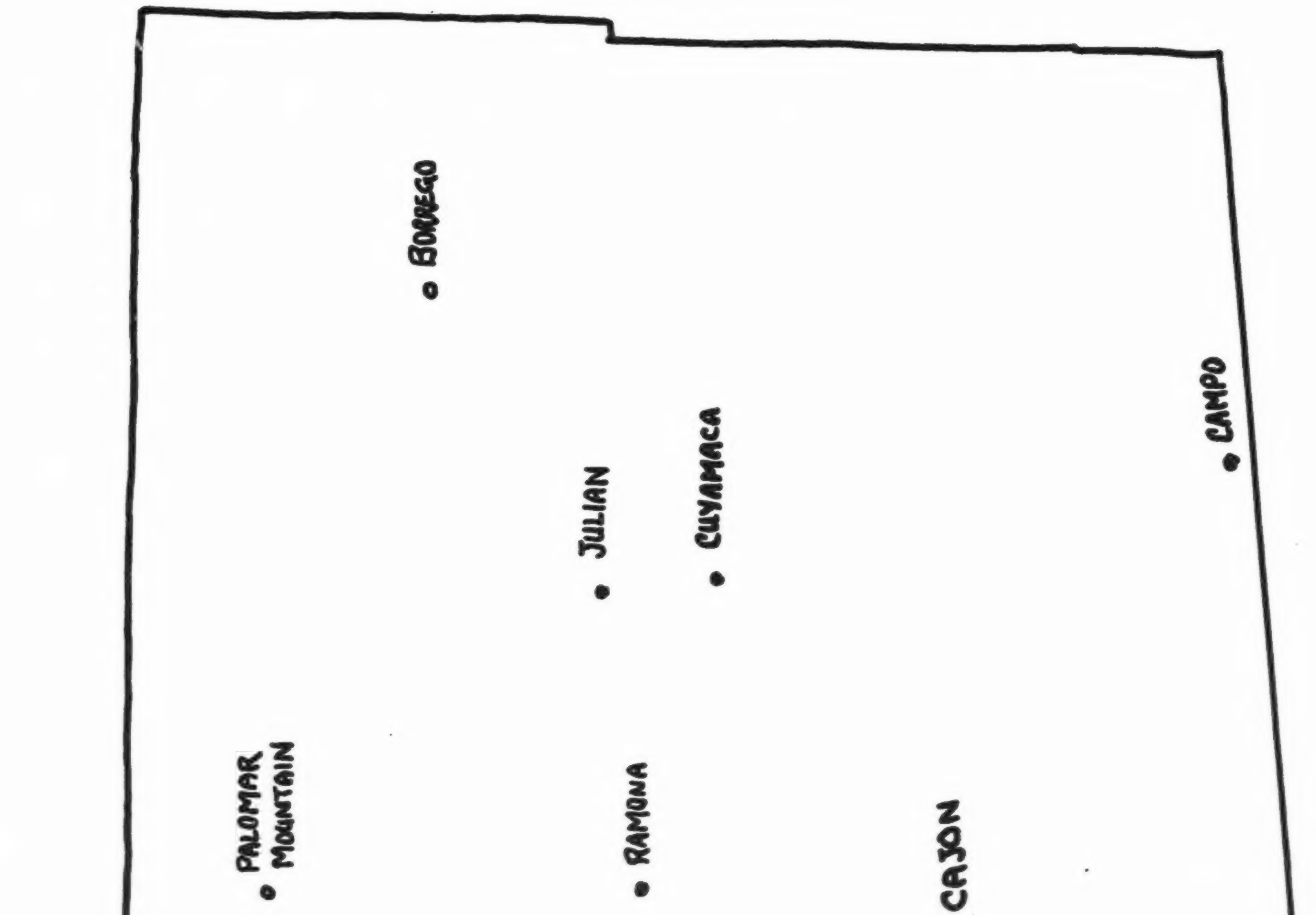
Weather Data for the Year 1965 (San Diego County) 218

Selected Publications on General Weather Science Study. 221

Hereditary Characteristics of Man 222


LA JOLLA
MIRAMAR
SAN DIEGO RIVER
RIVER
O SANTEE
EL CAJON O
O LA MESA
MURRAY RESERVOIR
LEMON GROVE O
SAN DIEGO
O NATIONAL CITY
O CHULA VISTA
SWEETWATER
SWEETWATER RESERVOIR
OTAY RESERVOIR
OTAY RIVER
TIJUANA RIVER

MAP of GREATER SAN DIEGO AREA

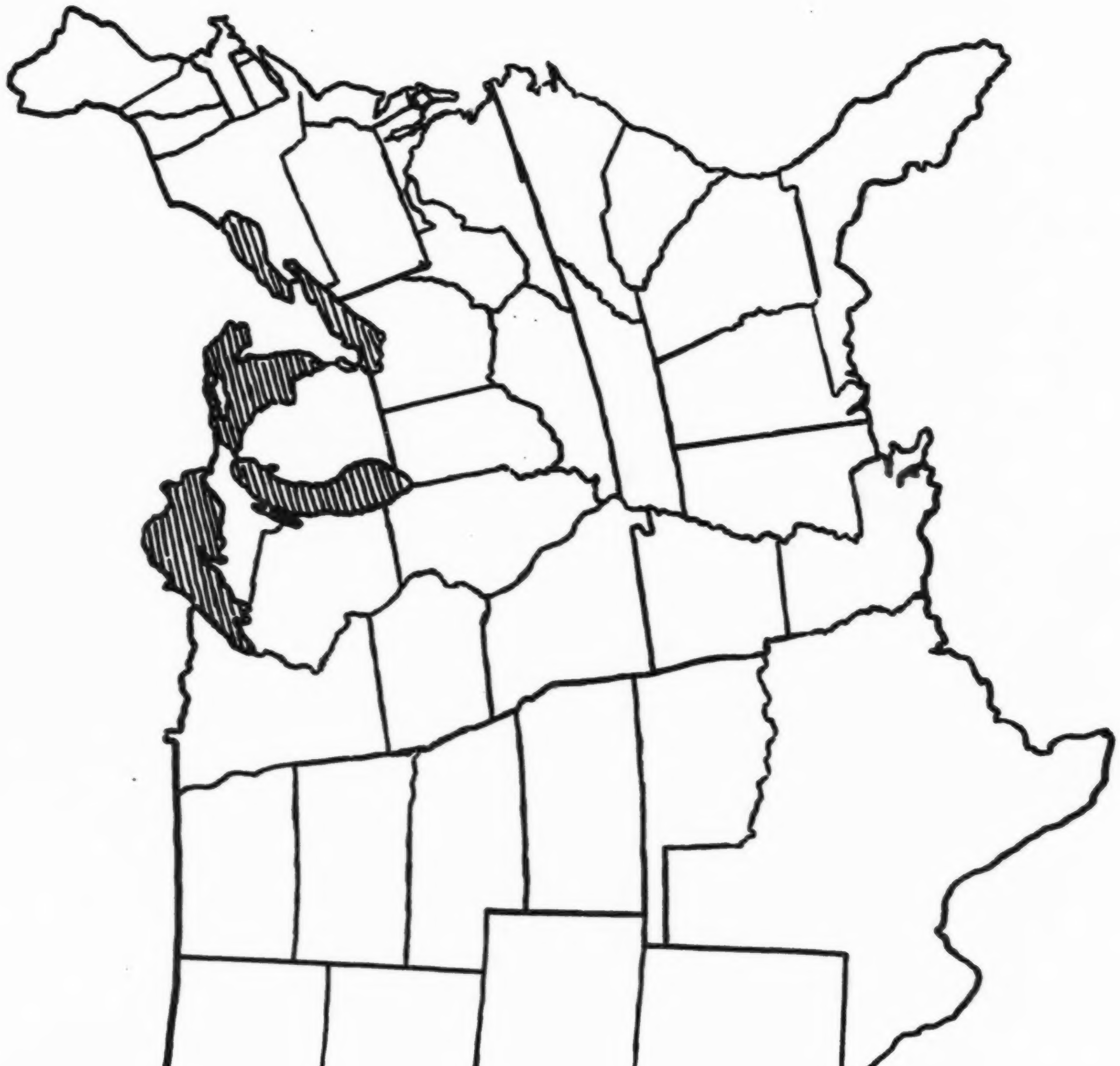

BORREGO
JULIAN
CUYAMACA
CAMPO
PALOMAR MOUNTAIN
RAMONA
EL CAJON
ESCONDIDO
SAN DIEGO
SAN ONOFRE
OCEANSIDE
DEL MAR
LA JOLLA

MAP
of
SAN DIEGO
COUNTY

MAP

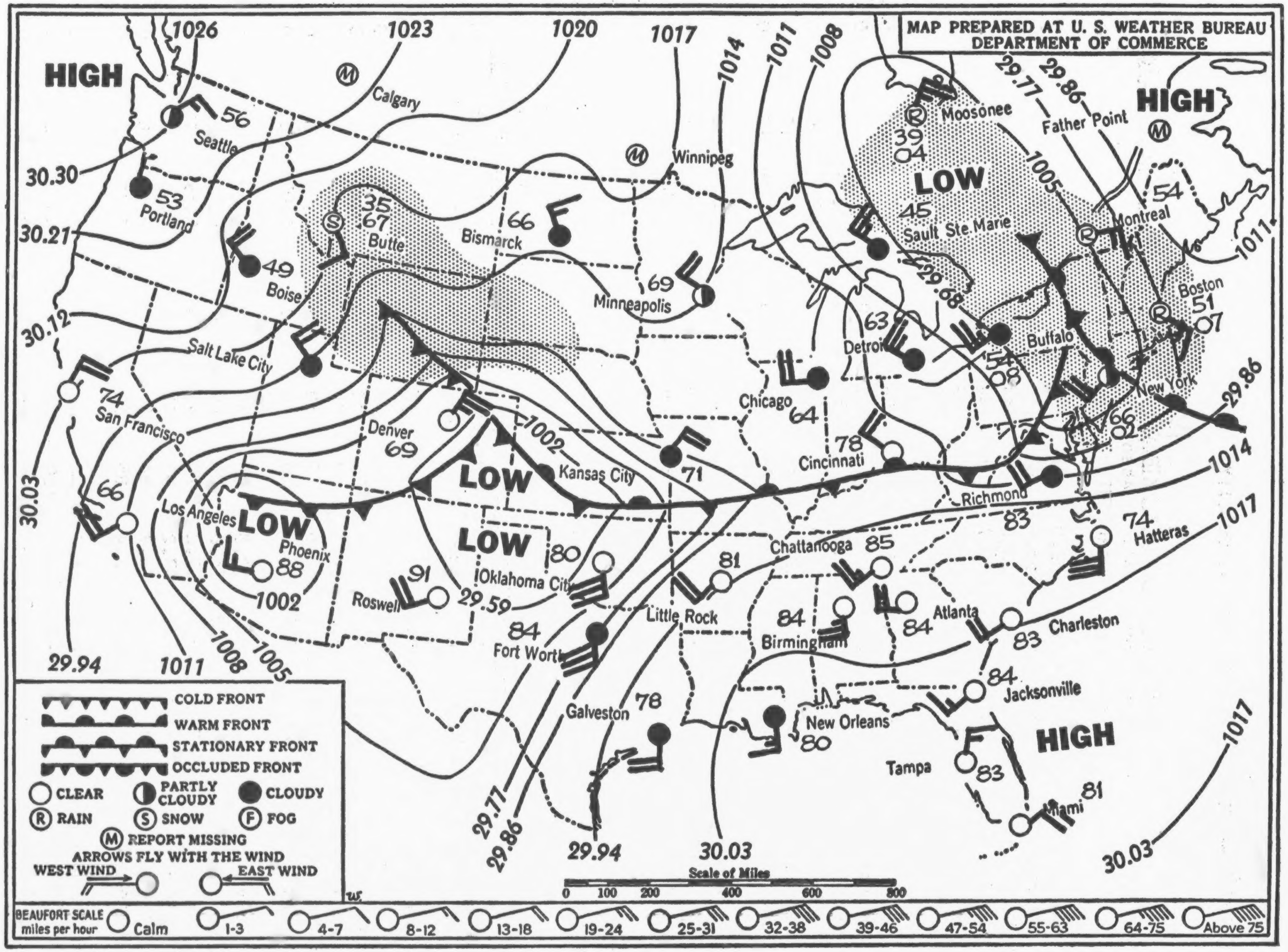
of

CALIFORNIA



MAP of UNITED STATES

UNITED STATES WEATHER MAP


MAP PREPARED AT U. S. WEATHER BUREAU
DEPARTMENT OF COMMERCE
HIGH
LOW
LOW
LOW
LOW
HIGH
HIGH
1026
1023
1020
1017
1014
1011
1008
1005
1002
30.30
30.21
30.12
30.03
29.94
29.86
29.77
29.68
29.59
Seattle
Portland
Boise
Butte
Calgary
Bismarck
Winnipeg
Minneapolis
Salt Lake City
San Francisco
Los Angeles
Phoenix
Denver
Roswell
Kansas City
Oklahoma City
Fort Worth
Galveston
Little Rock
Chicago
Cincinnati
Detroit
Sault Ste. Marie
Moosonee
Father Point
Montreal
Buffalo
Boston
New York
Richmond
Hatteras
Chattanooga
Atlanta
Birmingham
Charleston
Jacksonville
New Orleans
Tampa
Miami
COLD FRONT
WARM FRONT
STATIONARY FRONT
OCCLUDED FRONT
CLEAR
PARTLY CLOUDY
CLOUDY
RAIN
SNOW
FOG
REPORT MISSING
ARROWS FLY WITH THE WIND
WEST WIND
EAST WIND
Scale of Miles
0 100 200 400 600 800
BEAUFORT SCALE miles per hour
Calm
1-3
4-7
8-12
13-18
19-24
25-31
32-38
39-46
47-54
55-63
64-75
Above 75

Courtesy, United States Weather Bureau

WEATHER DATA FOR THE YEAR 1965
(From U.S. Weather Bureau Records)

REGION A -- COASTAL PLAIN: SAN DIEGO CITY

Elevation: 19 feet

	TEMPERATURE AVGS. & EXTREMES						PRECIPITATION		
	Mean High	Mean Low	Mo. Mean	Absolute High	Absolute Low	Days 32° or below	Total	Days With*	Snow-fall
January	65.8	46.1	56.0	81	39	0	0.40	2	0
February	65.3	46.5	55.9	80	38	0	0.52	2	0
March	66.4	50.8	58.6	80	44	0	1.79	4	0
April	68.4	52.9	60.7	81	44	0	3.58	7	0
May	68.1	56.8	62.5	76	49	0	T	0	0
June	68.2	59.2	63.7	72	55	0	0.01	0	0
July	73.2	62.2	67.7	83	59	0	0.02	0	0
August	77.7	66.2	72.0	89	63	0	T	0	0
September	75.0	62.0	68.5	88	56	0	0.29	1	0
October	79.6	59.2	69.4	104	51	0	T	0	0
November	67.3	54.4	60.9	75	45	0	5.82	10	0
December	63.7	46.5	55.1	83	40	0	6.60	10	0
Averages	69.9	55.2	62.6	—	—	-	—	-	-
Extremes	—	—	—	104	38	-	—	-	-
Totals	—	—	—	—	—	0	19.03	36	0

REGION B -- COASTAL VALLEY: ESCONDIDO

Elevation: 700 feet

	TEMPERATURE AVGS. & EXTREMES						PRECIPITATION		
	Mean High	Mean Low	Mo. Mean	Absolute High	Absolute Low	Days 32° or below	Total	Days With*	Snow fall
January	67.0	39.4	53.2	86	28	7	0.51	2	0
February	67.4	38.3	52.9	81	28	6	1.39	2	0
March	65.4	44.1	54.8	79	32	1	1.94	6	0
April	72.4	46.8	59.6	97	38	0	4.68	11	0
May	73.8	51.1	62.5	87	39	0	0.09	0	0
June	73.8	54.6	64.2	84	45	0	0.07	0	0
July	84.9	56.0	70.5	95	49	0	0.57	1	0
August	89.3	61.8	75.6	100	56	0	0.0	0	0
September	79.3	55.1	67.2	90	47	0	0.35	2	0
October	83.2	51.2	67.2	97	41	0	0.03	0	0
November	69.3	48.0	58.7	84	35	0	8.18	8	0
December	64.5	40.3	52.4	85	32	4	5.77	12	0
Averages	74.2	48.9	61.6	—	—	-	—	-	-
Extremes	—	—	—	100	28	-	—	-	-
Totals	—	—	—	—	—	18	23.58	44	0

*0.10 or more

REGION C — INTERMEDIATE ZONE: RAMONA

Elevation: 1450 feet

	TEMPERATURE AVGS. & EXTREMES						PRECIPITATION		
	Mean High	Mean Low	Mo. Mean	Absolute High	Absolute Low	Days 32° or below	Total	Days With*	Snow-fall
January	66.4	39.1	52.8	83	27	7	0.94	4	0
February	68.5	35.2	51.9	83	25	10	1.19	3	0
March	65.9	40.2	53.1	82	25	2	2.01	4	0
April	71.4	41.6	56.5	94	34	0	5.63	11	0
May	76.2	43.9	60.1	94	29	1	0.15	0	0
June	76.8	49.4	63.1	90	38	0	0.05	0	0
July	91.0	50.1	70.6	103	41	0	0.68	1	0
August	95.5	56.2	75.9	107	43	0	T	0	0
September	84.1	47.3	65.7	97	38	0	0.71	3	0
October	88.5	47.8	68.2	100	34	0	0.01	0	0
November	70.2	45.1	57.7	90	34	0	8.52	8	0
December	63.4	40.1	51.8	86	29	8	5.18	10	T
Averages	76.5	44.7	60.6	—	—	-	—	-	-
Extremes	—	—	—	107	25	-	—	-	-
Totals	—	—	—	—	—	28	25.07	44	T

REGION C — INTERIOR VALLEY: CAMPO

Elevation: 2590 feet

	TEMPERATURE AVGS. & EXTREMES						PRECIPITATION		
	Mean High	Mean Low	Mo. Mean	Absolute High	Absolute Low	Days 32° or below	Total	Days With*	Snow-fall
January	62.3	35.5	48.9	75	22	13	0.80	4	0
February	63.2	31.0	47.1	78	20	18	2.00	3	0
March	61.0	35.4	48.2	76	23	11	1.20	4	0
April	69.3	37.3	53.3	88	28	5	6.03	11	0
May	74.7	38.8	56.8	90	27	4	0.05	0	0
June	76.0	42.2	59.1	90	35	0	0.0	0	0
July	91.7	50.8	71.3	102	41	0	0.36	1	0
August	94.5	53.6	74.1	102	41	0	0.13	0	0
September	82.0	45.2	63.4	96	34	0	0.37	2	0
October	84.8	44.2	64.5	96	30	1	T	0	0
November	67.5	40.5	54.0	85	26	5	9.03	7	0
December	58.7	35.5	47.1	75	27	11	4.31	10	T
Averages	73.8	40.8	57.3	—	—	-	—	-	-
Extremes	—	—	—	102	20	-	—	-	-
Totals	—	—	—	—	—	68	24.28	42	T

*0.10 or more

REGION C — MOUNTAIN AREA: PALOMAR OBSERVATORY

Elevation: 5515 feet

	TEMPERATURE AVGS. & EXTREMES						PRECIPITATION		
	Mean High	Mean Low	Mo. Mean	Absolute High	Absolute Low	Days 32° or below	Total	Days With*	Snow-fall
January	58.0	34.9	46.5	69	(a)	(a)	1.06	2	T
February	58.4	33.8	46.1	76	19	14	1.69	2	1.6
March	54.9	32.2	43.6	69	26	19	1.67	5	1.5
April	58.4	38.2	48.3	78	22	14	12.27	11	25.5
May	66.9	41.9	54.4	80	26	6	T	0	0.0
June	72.2	45.2	58.7	81	30	3	T	0	0.0
July	83.6	59.1	71.4	90	53	0	1.29	1	0.0
August	84.9	60.1	72.5	90	50	0	0.0	0	0.0
September	75.2	48.8	62.0	86	35	0	0.75	3	0.0
October	80.2	52.0	66.1	90	32	1	T	0	0.0
November	60.1	40.0	50.1	78	25	5	21.80	8	T
December	52.0	32.1	42.1	73	21	(a)	7.94	11	11.0
Averages	67.1	43.2	55.2	—	—	-	—	-	-
Extremes	—	—	—	90	19(b)	-	—	-	-
Totals	—	—	—	—	—	62(c)	48.47	43	39.6

REGION D — DESERT AREA: BORREGO SPRINGS

Elevation: 500 feet

	TEMPERATURE AVGS. & EXTREMES						PRECIPITATION		
	Mean High	Mean Low	Mo. Mean	Absolute High	Absolute Low	Days 32° or below	Total	Days With*	Snow-fall
January	70.6	38.6	54.6	84	27	5	0.02	0	0
February	74.7	39.7	57.2	89	25	5	0.0	0	0
March	75.1	46.1	60.4	85	32	1	0.05	0	0
April	81.0	52.7	66.9	102	40	0	0.74	3	0
May	89.8	57.1	73.5	102	42	0	0.0	0	0
June	94.7	59.5	77.1	105	49	0	0.0	0	0
July	104.8	68.9	86.9	113	61	0	0.21	2	0
August	104.1	69.4	86.8	110	59	0	0.0	0	0
September	93.7	57.7	75.7	105	42	0	0.0	0	0
October	92.8	55.2	74.0	105	44	0	0.0	0	0
November	75.0	48.7	61.9	93	38	0	2.51	5	0
December	65.1	41.5	53.3	80	34	0	1.06	5	0
Averages	85.1	52.9	69.0	—	—	-	—	-	-
Extremes	—	—	—	113	25	-	—	-	-
Totals	—	—	—	—	—	11	4.64	15	0

*0.10 or more
(a) Not reported
(b) For 11 months only
(c) For 10 months only

Selected Publications on
GENERAL WEATHER SCIENCE STUDY

☐ The aneroid barometer. (The purpose of this publication is to assist amateur meteorologists and others who own aneroid barometers in obtaining an understanding of the operation and use of these instruments.) 15¢. Catalog No. C 30.2:B 26/2

Aviation series (aimed at helping pilots to apply weather knowledge to practical flight problems): Catalog No. C 30.65:(no.)

☐ 1. Flying weather forecasts, how useful are they? 5¢.

☐ 2. Ice on aircraft, its causes and effects. 5¢.

☐ 3. Jet stream, bank of very fast winds found at high altitudes. 5¢.

☐ 4. Turbulence, its causes and effects. 5¢.

☐ 5. Mountain wave, what it means to the pilot. 5¢.

☐ 6. Storm detection radar, how it helps the pilot. 5¢.

☐ 7. Thunderstorms, pt. 1. 5¢.

☐ 8. Thunderstorms, pt. 2. 5¢.

☐ 9. Flying weather information, what it means to the pilot. 5¢.

☐ 10. Ceiling, how it is determined and what it means to the pilot. 5¢.

☐ 11. Visibility, how it is determined and what it means to the pilot. *Out of print.*

☐ 12. Tips on weather for VFR flight. 5¢.

☐ 13. Fronts, their significance to flying. 5¢.

☐ 14. Weather reports from pilots, how in-flight reports help others. *Out of print.*

☐ 15. Aeronautical climatology, low ceilings and visibilities. 5¢.

☐ 16. Aeronautical climatology, thunderstorms. 5¢.

☐ 17. Severe weather forecasts, their importance to the pilot. 5¢.

☐ 18. Altimeters, how their readings are affected by temperature and other factors. 5¢.

☐ —— Set of aviation series pamphlets, Nos. 1–18 (except Nos. 11 and 14 which are out of print). 75¢. Catalog No. C 30.65:1–18

☐ Climate of the United States. (46 charts of climatic data showing weather conditions of the United States.) 20¢. Catalog No. A 1.10/a:1824

☐ The climates of the world. (Gives data on mean and extreme temperatures and monthly and yearly precipitation for 387 representative stations throughout the world, exclusively of the United States.) 10¢. Catalog No. A 1.10/a:1822

☐ Lightning. (Gives information on the causes and effects of lightning and includes some simple safety rules to keep in mind when lightning is nearby.) 5¢. Catalog No. C 30.2:L 62

☐ Community tornado safety. (Tornadoes occur in every State and as towns expand, the chances of being visited by a tornado are increased. Advance preparation can save lives, reduce public alarm, and prevent disruption of business during threatening weather. The model warning plan described here offers suggestions to assist local authorities and other civic-minded citizens to develop a plan of action to prevent casualties from tornadoes. In operation, the plan is practical, inexpensive, and can be modified as necessary to best fit the needs of the community.) 10¢. Catalog No. C 30.2:T 63/6

☐ Cooperative weather observer. 65¢. Catalog No. C. 30.66/2:1.11

☐ Employment outlook for geologists, geophysicists, meteorologists. 10¢. Catalog No. L 2.3:1300–44

☐ The hurricane. (A description of tropical disturbances known as hurricanes.) 20¢. Catalog No. C 30.2:H 94/2/956

☐ Hurricane tracking chart. (By using the Weather Bureau advisories and bulletins as disseminated by press, radio, and television the location and movement of a hurricane can be followed on this chart. It also includes information on hurricane warnings and safety precautions and measures.) 10¢. Catalog No. C 30.22:H 94/959

☐ Hurricane warnings, brief description of hurricanes, hurricane warnings, and hurricane safety precautions for Gulf and Atlantic coast areas. 5¢. Catalog No. C 30.2:H 94/3/962

☐ Instructions for climatological observers, Circular B. (Methods of taking observations of rainfall, temperature, and other weather conditions.) 50¢. Catalog No. C 30.4:B/962

☐ Instruments used in weather observing. (Shows principal instruments used when taking weather observations.) 5¢. Catalog No. C 30.2:In 7

☐ It looks like a tornado, an aid for distinguishing tornadoes from other cloud forms. 10¢. Catalog No. C 30.6/2:T 63

☐ Cloud code chart. (36 pictures of cloud formations.) 10¢. Catalog No. C 30.22:C 62/2/958

☐ Tornado safety rules, to kno[illegible] do when a tornado is approaching, may mean the difference between life or death! [all lettered poster]. 10.5 x 8 in. 5¢. Catalog No. C 30.6:T 63/2/960

☐ Tornadoes, what they are and what to do about them. (Tells about tornadoes, tornado warnings, tornado precautions.) 5¢. Catalog No. C 30.2:T 63/4/962

☐ The Weather Bureau at work. (A nontechnical account of Weather Bureau activities.) 10¢. Catalog No. C 30.2:W 37/7

☐ Weather forecasting. (Summary of methods of weather reporting and forecasting.) 25¢. Catalog No. C 30.2:F 76/3

Supplies of all publications listed are limited, and prices are subject to change without advance notice.

Rules of this Office require remittance in advance of shipment of publications. Checks and money orders should be made payable to the Superintendent of Documents. Postage stamps and foreign money are not acceptable.

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HEREDITARY CHARACTERISTICS OF MAN

Definitions

Character - any trait that an offspring possesses.

Dominant - a characteristic or trait that will usually show up in an offspring.

Recessive - a characteristic that will not ordinarily show up, but is carried by the genes of the offspring.

Chromosomes - minute filaments that contain genes (present in the nuclei.)

Genes - the hereditary factors contained in the chromosomes.

Types of Inheritance

1. Direct - child resembles father or mother.
2. Interrupted - child resembles grandparent.
3. Collateral - child resembles uncle or aunt.
4. Atavism - child resembles remote ancestor. (Also called reversion. Breeders call this a throwback.)

	Character	Dominant	Recessive
Normal	Hair form	Curly	Straight
	Hair color	Dark	Light
	Skin color	Dark	Light
	Skin pigmentation	Normal	Albinism (no pigment)
Abnormal	Fingers and toes	Short	Normal length
		"Webbed"	Normal, not fused
		Extra digits	Normal, 5/hand and foot
	Nervous function	Normal	Hereditary epilepsy
		Normal	Feeble-minded
		Normal	Insanity (also caused by organic disturbance)
	Ear	Normal hearing	Deaf-mutism
Sex-linked	Color vision	Normal	Color-blind (cannot distinguish red and green)
	Clotting of blood	Normal	Hemophilia (clots slowly if at all)

Appendix B: Worksheets

Pages

Metric System Practice Sheet (2) 224
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Human Ear 240
Human Eye 241

For measuring areas, the square meter or the square centimeter is generally used. A floor that is 4 meters long and 3 meters wide has an area of 12 square meters.

For measuring volumes, the cubic meter is generally used. A bin 3 meters long, 2 meters wide, and $3\frac{1}{2}$ meters deep has a volume of 21 cubic meters. For small measurements, the cubic centimeter is used. Glass containers used for measuring are often marked off in cubic centimeters (cc).

The liter is used in measuring liquids or solids. The liter is equal to 1000 cubic centimeters, or 1 cubic decimeter (cu.dm.).

A gram is the metric unit of weight. A nickel weighs approximately 5 grams. One cc of water weighs one gram at a temperature of 4 degrees centigrade. A liter of water, or 1000 cubic centimeters, weighs one kilogram.

A metric ton is sometimes used; it is equal to 1000 kilograms.

Exercises and Problems

1. Find the volume of a metal block 10 centimeters long, 8 centimeters wide, and 6 centimeters in depth.

   480 cm^3

2. Find the volume of the air in a room 8 meters long, 6.2 meters wide, and 2.8 meters high.

   138.88 m^3

3. An aquarium is 50 centimeters long, 25 centimeters wide, and 45 centimeters deep. How many liters will it hold?

   56.25 l.

4. Express 8 cu.dm. as cc. 8000 cc

5. How many grams are there in 6 kilograms?

   6,000 grams

6. Forty grams equal .04 or 1/25 kg.

Since we have the two systems it is desirable to know the values of the metric units when compared to the English. The meter is longer than a yard. To change meters to yards, we must first find out how many yards there are in the meter. To do this, divide 39.37 by 36. The answer will be a little over one.

A liter is a little larger than a quart. One liter is equal to 1.06 quarts.

24. One quart equals .94 liters.

25. How many liters are there in one gallon? 3.8 l.

26. Three pints are how many liters? 1.4 l.

27. If you are traveling in France and wish to buy 5 gallons of gasoline, how many liters do you buy? 18.8 l.

A gram is a very small unit. A new 5¢ piece weighs exactly 5 grams. A kilogram equals 2.2 pounds.

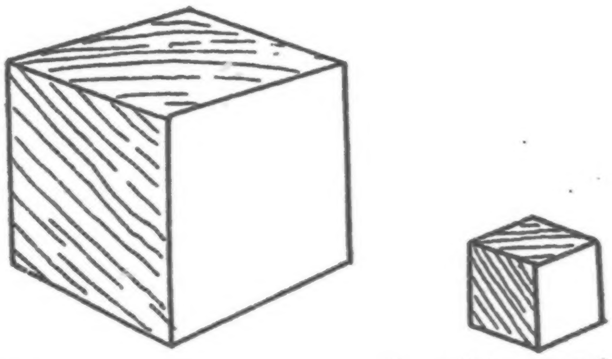
28. How many pounds are there in 8 kilograms? 17.6 lb.

29. One pound equals .454 kilograms.

30. One pound equals 454 grams.

31. If you were in Mexico and wished to buy 10 pounds of sugar, how many kilograms would you buy? 4.54 kg.

32. Express your weight in kilograms. ____________



1 cubic inch
1728 cu. in = 1 cu.ft.

1 cubic centimeter
1000 cc = 1 liter

A COMPARISON OF MEASURES OF VOLUME

NAME____________________________

DAILY WEATHER RECORD

Purpose

To provide a systematic form for the keeping of weather records.

Day and Date	Hour of Day	Temperature	Barometric Pressure	Dry Bulb Temperature	Wet Bulb Temperature	Relative Humidity	Direction of Wind	Kinds of Clouds	Form of Precipitation	Probable Weather Forecast
Mon.										
Tues.										
Wed.										
Thurs.										
Fri.										
Sat.										
Sun.										
Mon.										
Tues.										
Wed.										
Thurs.										
Fri.										

VARIATION CHART

Hairline	Mid-digital hair	Hair form	Tongue rolling	Taste ability	Index finger	
Widow's Peak	Present	Straight	Can	Taster	Short	1
					Long	2
				Non-taster	Short	3
					Long	4
			Cannot	Taster	Short	5
					Long	6
				Non-taster	Short	7
					Long	8
		Wavy	Can	Taster	Short	9
					Long	10
				Non-taster	Short	11
					Long	12
			Cannot	Taster	Short	13
					Long	14
				Non-taster	Short	15
					Long	16
		Curly	Can	Taster	Short	17
					Long	18
				Non-taster	Short	19
					Long	20
			Cannot	Taster	Short	21
					Long	22
				Non-taster	Short	23
					Long	24
	Absent	Straight	Can	Taster	Short	25
					Long	26
				Non-taster	Short	27
					Long	28
			Cannot	Taster	Short	29
					Long	30
				Non-taster	Short	31
					Long	32
		Wavy	Can	Taster	Short	33
					Long	34
				Non-taster	Short	35
					Long	36
			Cannot	Taster	Short	37
					Long	38
				Non-taster	Short	39
					Long	40
		Curly	Can	Taster	Short	41
					Long	42
				Non-taster	Short	43
					Long	44
			Cannot	Taster	Short	45
					Long	46
				Non-taster	Short	47
					Long	48

INSTRUCTIONS Can you be distinguished from your classmates by these six basic inheritance traits listed on the chart? Check only the one trait which applies to you in each column and circle the number.

1. Hairline--Indicate by checking the correct word in the first column on either side of the page that best describes your hairline. If your hair tends to form a V in the middle of your forehead, check Widow's peak. If the hairline does not grow in this manner, check Straight.

2. Mid-digital hair--Mark Present if there is any hair on the middle sections of digits of your fingers. Mark Absent if there is none.

GS 3-VI,2a

3. Hair form - Select the one word that best describes the structure of your hair, whether it is naturally straight, wavy, or curly.

4. Tongue roll - If you can turn up the sides of your tongue to form a U shape, check the Can choice. If you are unable to do this, check Cannot.

5. Taste ability - Phenolthiocarbamide (PTC) is a chemical that tastes very bitter to a person who has inherited a certain taste trait. To one who has not, there is no taste at all.

6. Index finger - Check to see if the index finger, which is next to the thumb, is longer or shorter than the one next to the little finger. Hold your hand in front of your face, palm out, and compare.

Hairline	Mid-digital hair	Hair form	Tongue rolling	Taste ability	Index finger	
Straight	Present	Straight	Can	Taster	Short	49
					Long	50
				Non-taster	Short	51
					Long	52
			Cannot	Taster	Short	53
					Long	54
				Non-taster	Short	55
					Long	56
		Wavy	Can	Taster	Short	57
					Long	58
				Non-taster	Short	59
					Long	60
			Cannot	Taster	Short	61
					Long	62
				Non-taster	Short	63
					Long	64
		Curly	Can	Taster	Short	65
					Long	66
				Non-taster	Short	67
					Long	68
			Cannot	Taster	Short	69
					Long	70
				Non-taster	Short	71
					Long	72
	Absent	Straight	Can	Taster	Short	73
					Long	74
				Non-taster	Short	75
					Long	76
			Cannot	Taster	Short	77
					Long	78
				Non-taster	Short	79
					Long	80
		Wavy	Can	Taster	Short	81
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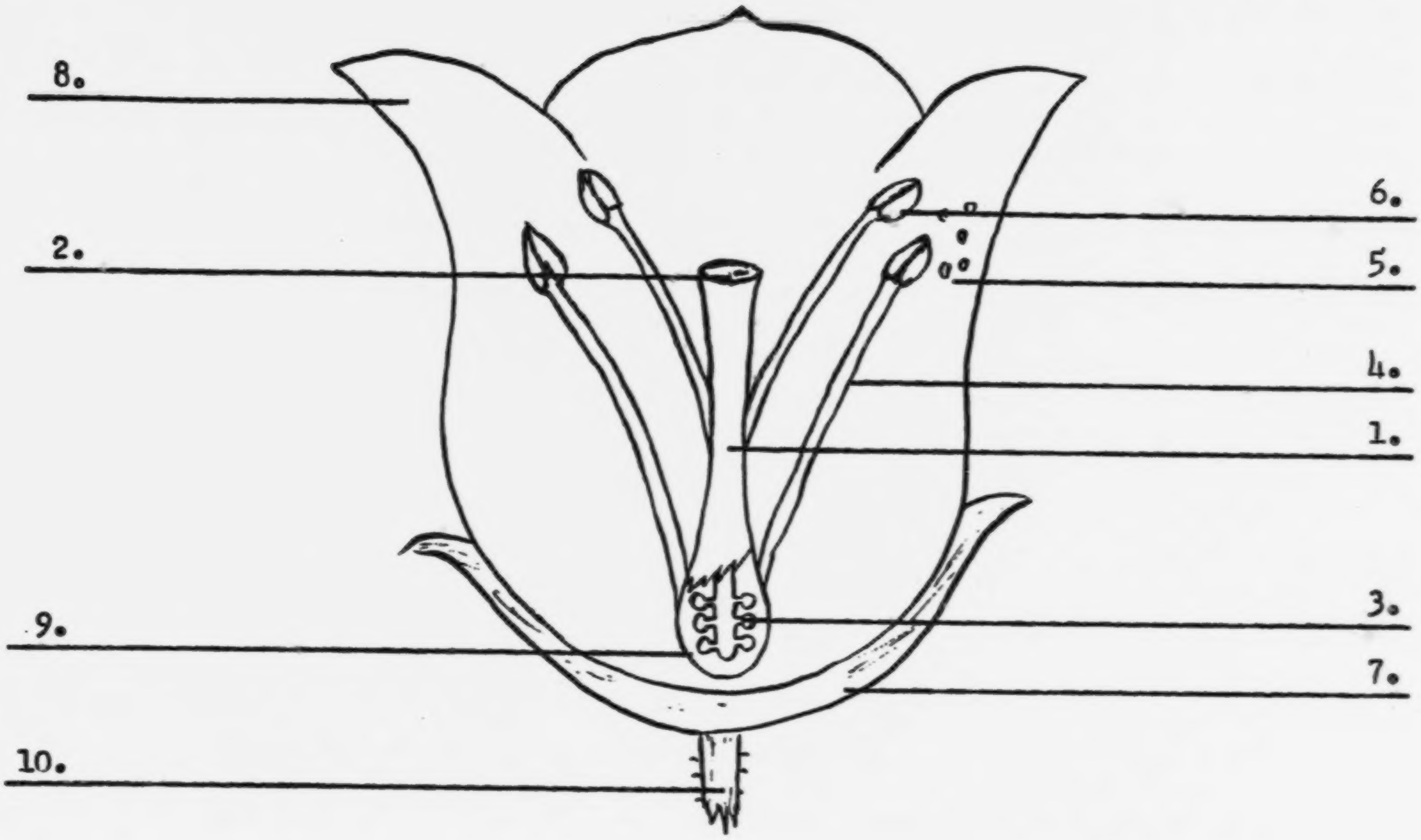
				Non-taster	Short	83
					Long	84
			Cannot	Taster	Short	85
					Long	86
				Non-taster	Short	87
					Long	88
		Curly	Can	Taster	Short	89
					Long	90
				Non-taster	Short	91
					Long	92
			Cannot	Taster	Short	93
					Long	94
				Non-taster	Short	95
					Long	96

NAME________________________________

PARTS OF THE FLOWER



Label the parts of the flower and complete the chart below as is indicated. In noting the sex of each specific part, use the following scientific symbol for sex designation. Male part of flower, ♂ . Female part of flower ♀ . Nonsexual parts, O.

Name of part	Sex	Function of the part
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

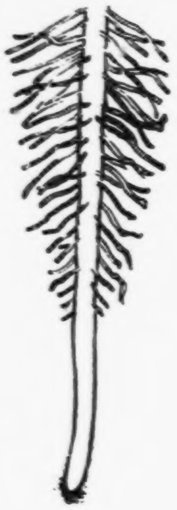
NAME____________________

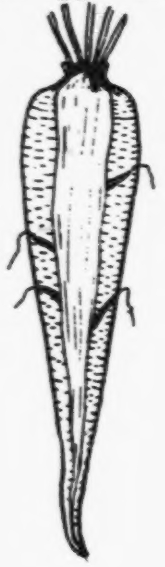
THE PARTS OF A ROOT

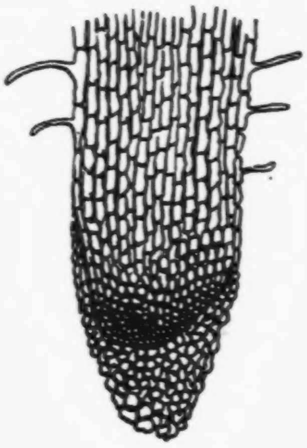
In the table below, state the function of each root part mentioned.

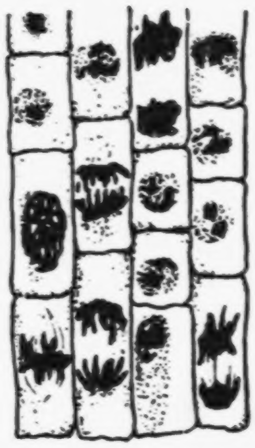
Part of Root	Function
1. Chromosomes	
2. Cortex	
3. Epidermis	
4. Lateral root	
5. Meristem	
6. Phloem	
7. Root cap	
8. Root hair	
9. Stele	
10. Xylem	

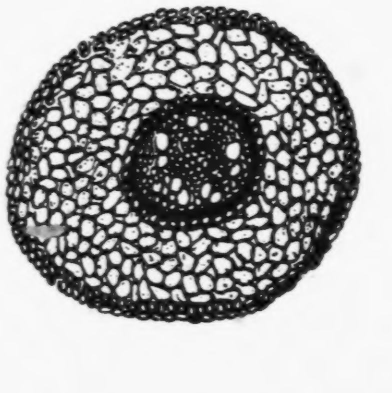
Now, look at the diagrams below. How many of the root parts in the table above can you recognize? Label each part with the correct number. Remember that the same part may appear in more than one diagram. If it does, label it as many times as it appears.

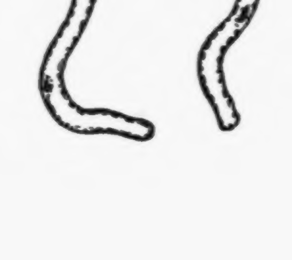












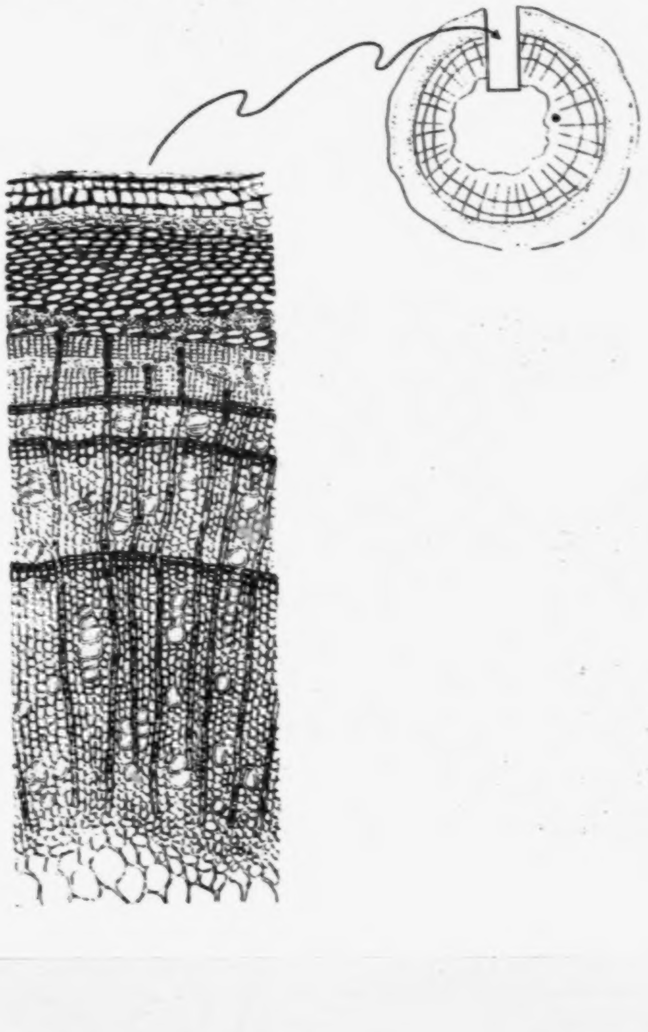
NAME________________________

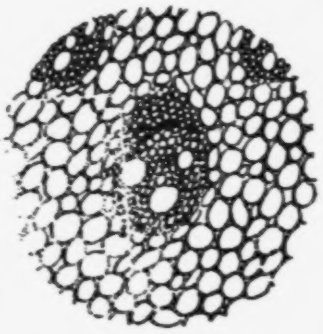
THE PARTS OF A STEM

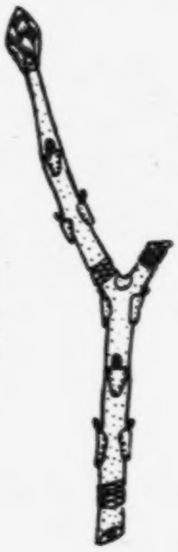
In the table below, state the function or description of each stem part mentioned.

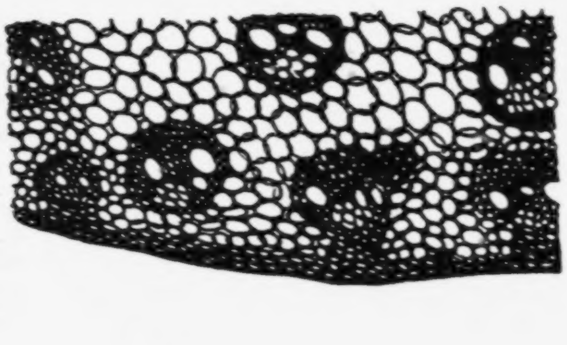
Part of Stem	Function or Description
1. Bark	
2. Bud scales	
3. Cambium	
4. Cortex	
5. Epidermis	
6. Lateral bud	
7. Leaf scars	
8. Lenticels	
9. Pith	
10. Terminal bud	
11. Vascular bundles	
12. Wood	

Now, look at the diagrams below. How many of the stem parts in the table can you recognize? Label each part with the correct number. Remember that the same part may appear in more than one diagram. If it does, label it as many times as it appears.









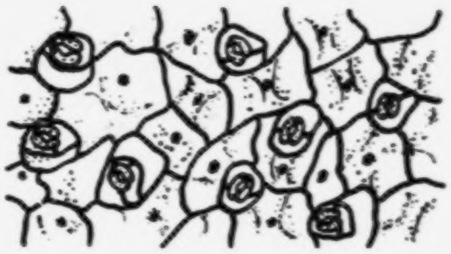
NAME________________

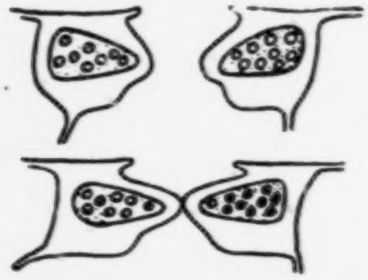
THE PARTS OF A LEAF

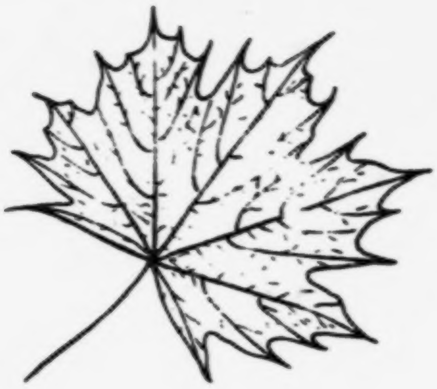
In the table below, state the function and location of each of the following leaf parts.

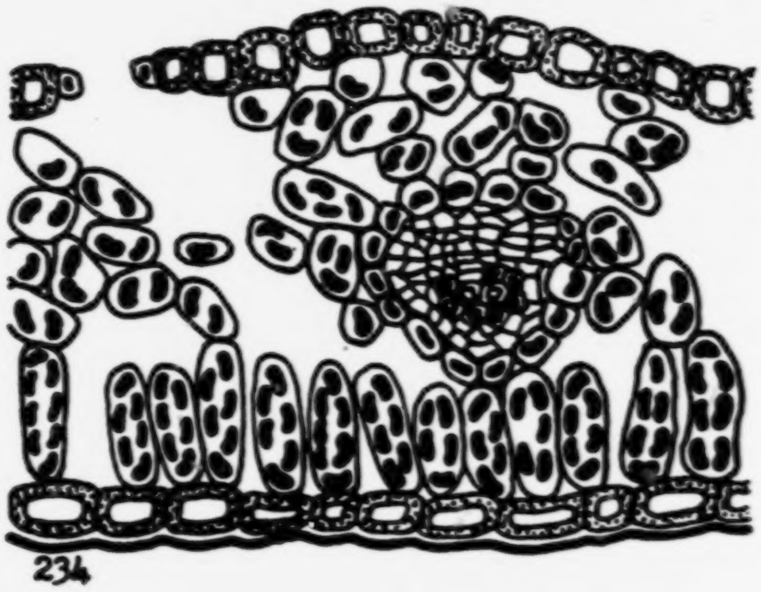
Part of Leaf	Function and Location
1. Air spaces	
2. Blade	
3. Chloroplasts	
4. Guard cells	
5. Lower epidermis	
6. Palisade layer	
7. Petiole	
8. Spongy layer	
9. Stomates	
10. Upper epidermis	
11. Veins	

Now, look at the diagrams below. How many of the leaf parts in the table can you recognize? Label each part with the correct number. Remember that the same part may appear in more than one diagram. If it does, label it as many times as it appears.









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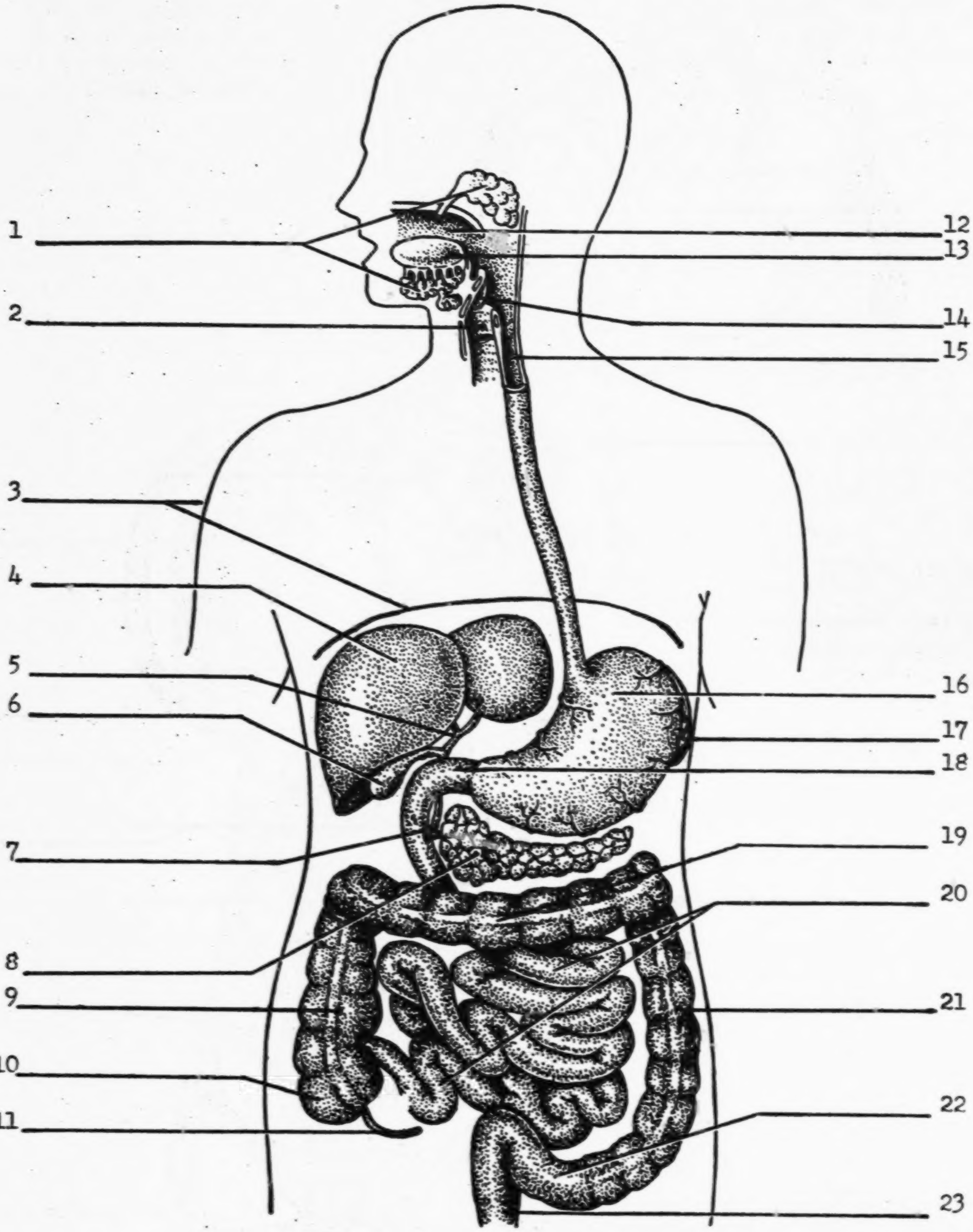
DIGESTIVE SYSTEM

Label the parts of the body that are indicated. Designate the different organs by coloring them in.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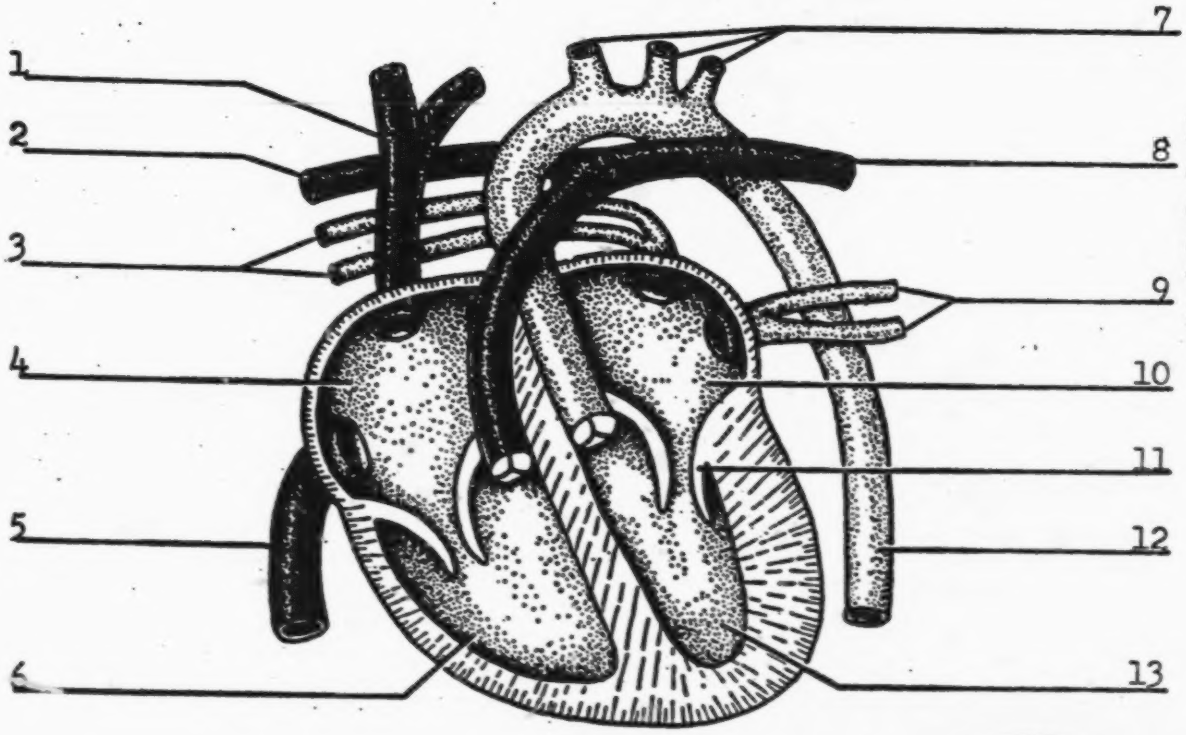
NAME____________________

CIRCULATION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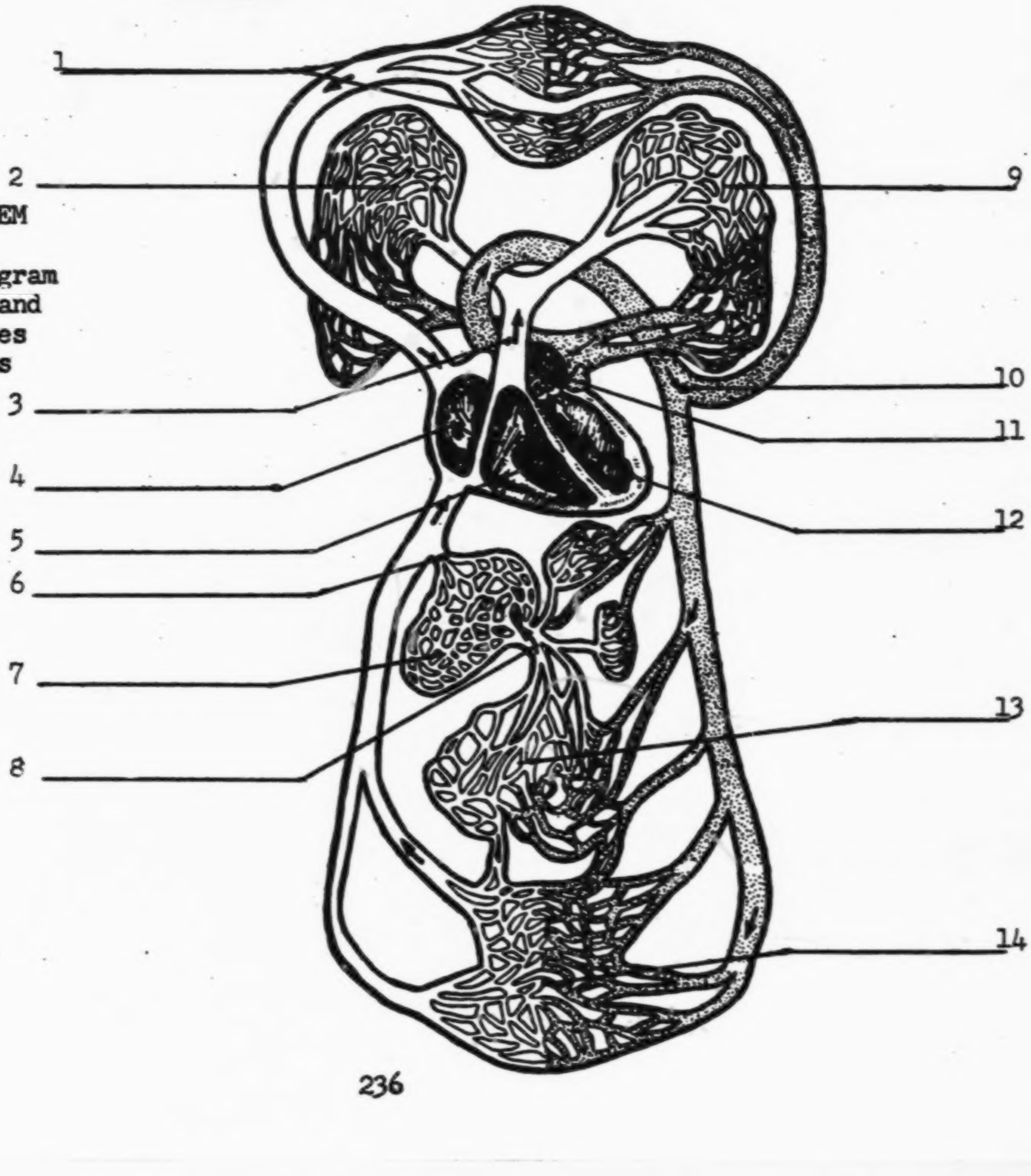
HEART

Label the human heart, showing veins, arteries, auricles, and ventricles, and add arrows to show the direction of the flow of blood.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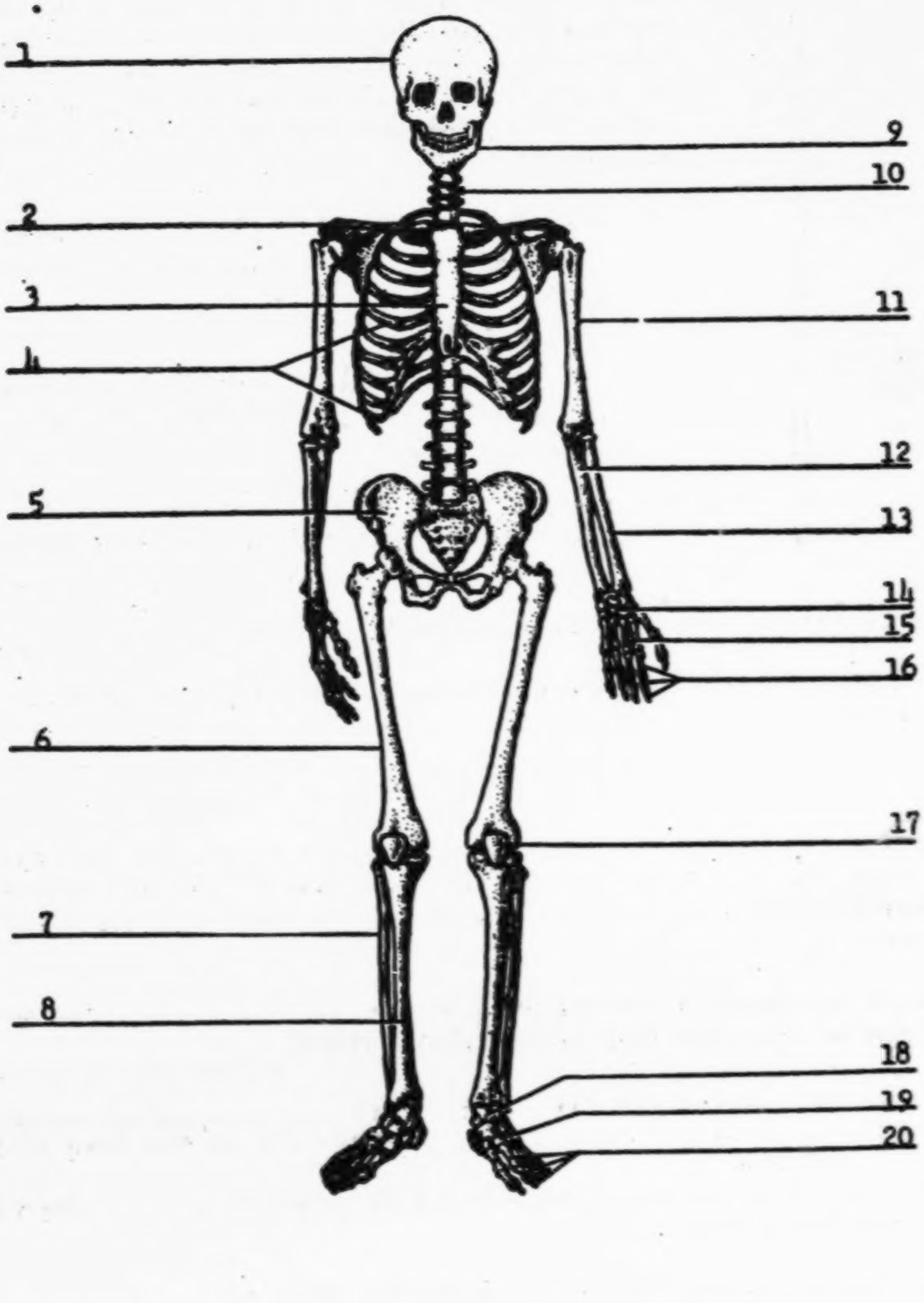
CIRCULATORY SYSTEM

In this diagram label the parts and color all arteries red and all veins blue.

NAME____________________

HUMAN SKELETON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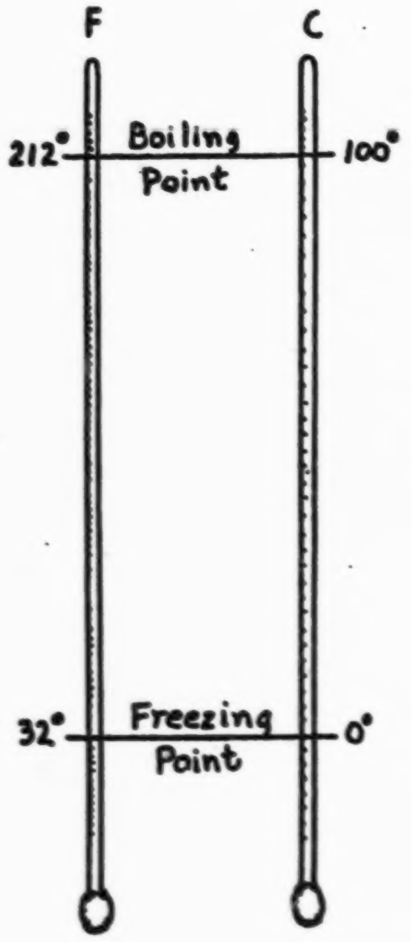
THERMOMETER PROBLEM SHEET



You are perhaps familiar with the two kinds of thermometers, those using the centigrade scale and those using the Fahrenheit scale. The Fahrenheit thermometer is in common use among the English speaking people. The centigrade thermometer is commonly used in some foreign countries and is most frequently used for scientific work everywhere.

Sometimes it is necessary to change a Fahrenheit thermometer reading to a centigrade reading, or vice versa. This is not hard to do. You have to know what the boiling and freezing points of water are on each scale and the rest of it is simple arithmetic.

1. (a) The boiling point on the Fahrenheit thermometer is ________________.

   (b) The freezing point is ____________.

   (c) How many degrees are there between the boiling and the freezing points?

   ____

2. (a) The boiling point on the centigrade scale is ________________________.

   (b) The freezing point on the centigrade scale is ____________.

   (c) How many degrees are there between the boiling and freezing points?

   ____________________________.

3. Imagine the degrees on the two thermometers to be steps. The distance is the same but the steps are not the same length. We can compare the two thermometers by saying that one has short steps and the other has long steps.

   (a) Which thermometer has the long steps? ______________ How many times as long are they as the short steps? ________________.

   (b) Which thermometer has the short steps? __________________. The short steps are only __________ as long as the long steps. (Give fraction.)

   (c) One degree on the centigrade scale is equal to ______ degrees on the Fahrenheit scale.

   (d) One degree on the Fahrenheit scale is equal to ______________ degree on the centigrade scale.

4. (a) What do 10 degrees on the centigrade thermometer correspond to on the Fahrenheit thermometer?

____

(b) What do 10 degrees on the Fahrenheit thermometer correspond to on the centigrade thermometer?

____

5. If the temperature of water drops from boiling to 90° C., to what temperature will it drop to on the Fahrenheit scale?

____

6. (a) If it is 10 degrees above freezing on the centigrade scale, how many degrees above freezing is it on the Fahrenheit scale?

____

(b) What temperature is it on the Fahrenheit scale? ______________

7. (a) When it is 0° F., how many degrees is it below freezing on the same scale?

____

(b) What temperature is it on the centigrade scale? ______________

8. (a) When it is -10° F., how many degrees is it below the freezing point on the same scale?

____

(b) Change -10° F. to centigrade degrees. ______________

9. The ideal indoor temperature is 68° F. To change this to a centigrade reading, we first find out how many degrees it is above the freezing point. It is 36 degrees. (68° - 32° = 36°.) Now, change the 36 Fahrenheit degrees to centigrade degrees.

68° F. = ______________ C.

10. Mercury freezes at about -39° C., therefore a mercury thermometer cannot be used to measure temperatures below that point. What Fahrenheit temperature is this? (Hint: First, change the 39 centigrade degrees to Fahrenheit degrees.)

____

11. Alcohol thermometers are used in the polar regions where temperatures drop below the freezing point of mercury. The freezing point of ordinary alcohol is -130° C. What is its freezing point on the Fahrenheit scale?

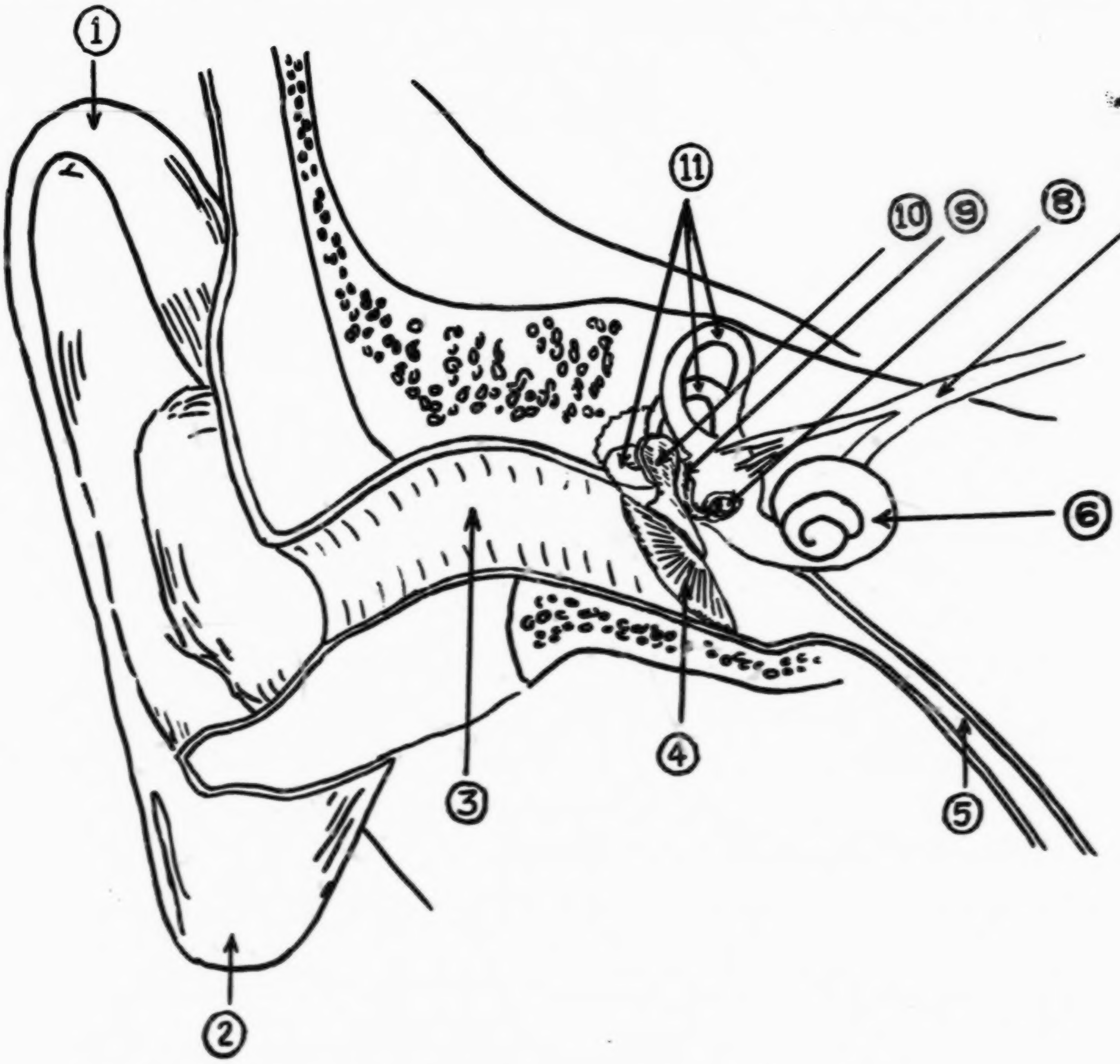
____

12. Normal body temperature is 98.6° F. What is it on the centigrade scale?

____

HUMAN EAR

NAME ______________________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NAME - FUNCTION

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2 ______________________

3 ______________________

4 ______________________

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6 ______________________

7 ______________________

8 ______________________

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11 ______________________

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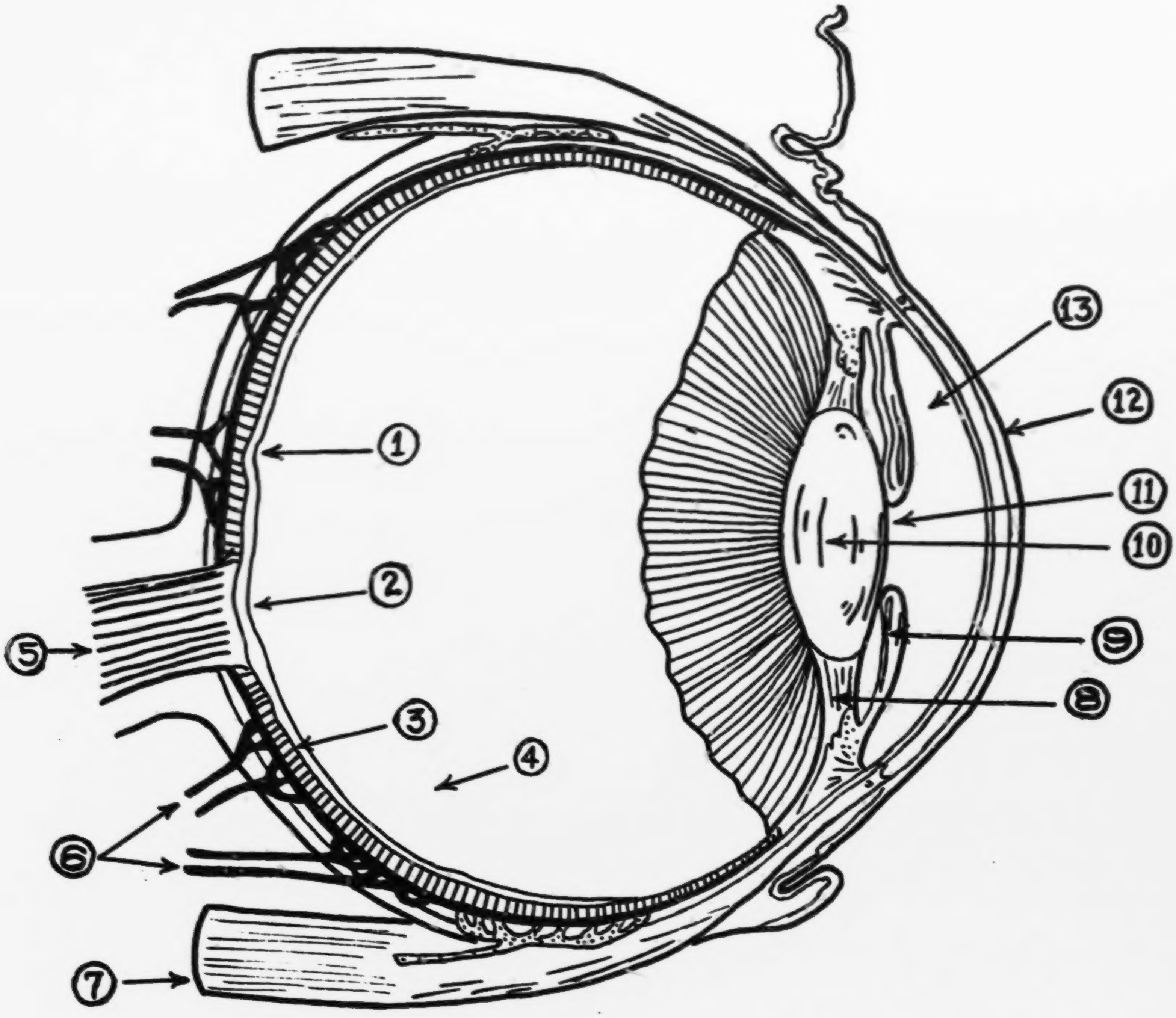
HUMAN EYE

NAME ____________________



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NAME - FUNCTION

1 ____________________

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4 ____________________

5 ____________________

6 ____________________

7 ____________________

8 ____________________

9 ____________________

10 ____________________

11 ____________________

12 ____________________

13 ____________________

Appendix C: Laboratory Exercises

Pages

Orientation to the Laboratory 243

Measurement and Observation 247

Physical and Chemical Changes 253

Elements, Compounds and Mixtures 257

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Use and Care of the Microscope 268

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Electricity and Magnetism 297

Orientation to the Laboratory - Teacher Information

This exercise is designed to familiarize the student with a variety of simple apparatus commonly used in the science laboratory. He should learn to recognize each piece of apparatus, use the correct name and know what its function is. He should also become familiar with general laboratory practices and procedures.

Proper student attitude toward the laboratory and its equipment should be one of the major aims of the first several laboratory exercises, as this will set patterns to be followed later.

Materials:

Any of the materials (and others) may be on display for student observation. The teacher should go over the laboratory exercise with the students, especially the diagrams of laboratory equipment, discussing use, nomenclature and perhaps relative cost of equipment.

Special mention should be made of the necessity for carefully following laboratory directions without deviating, following good safety practices, and the need for and use of safety glasses.

EXERCISE NO.______________ NAME__________________

Orientation to the Laboratory

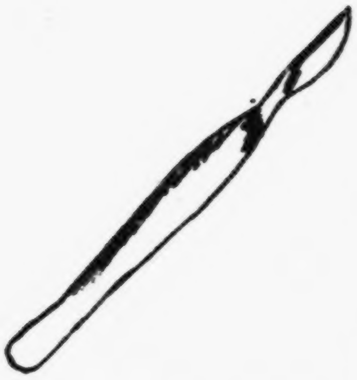
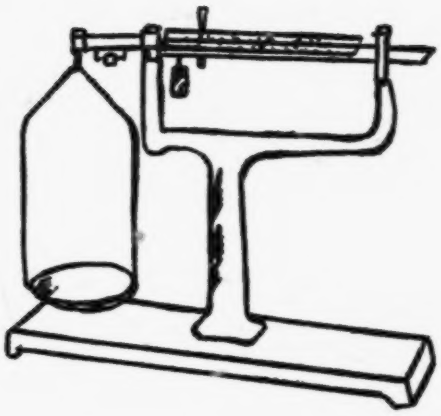
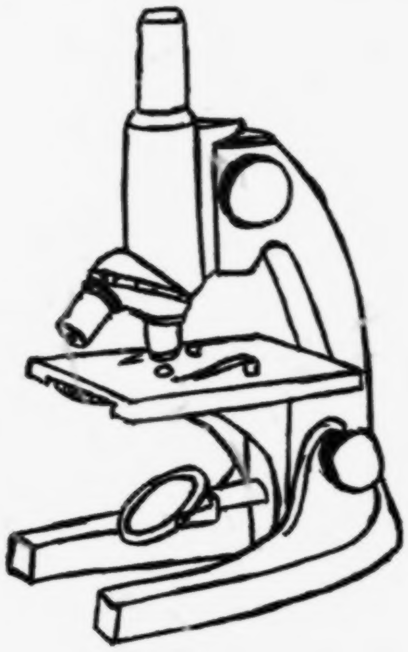
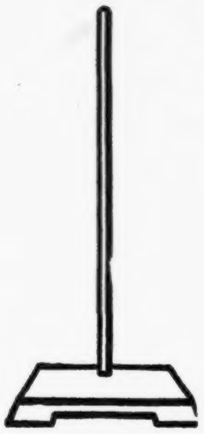
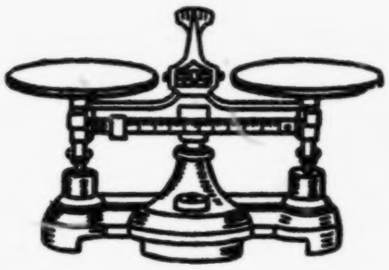
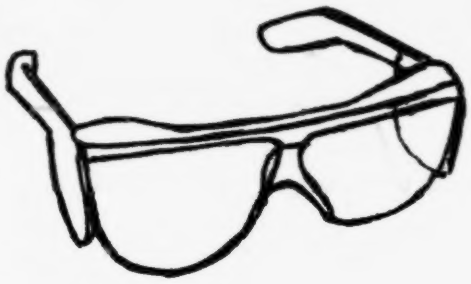
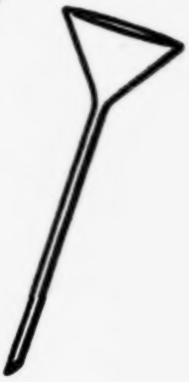
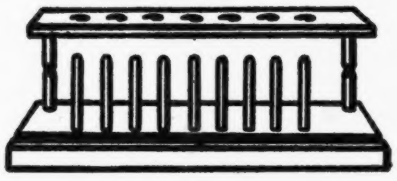
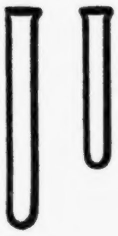
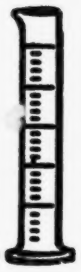
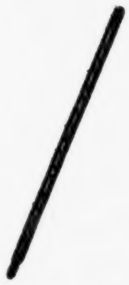
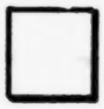
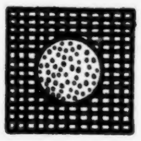
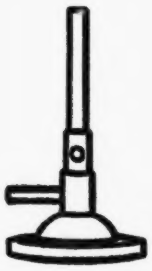
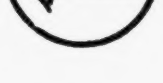
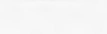
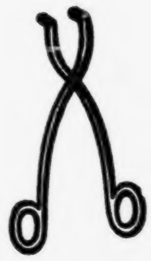
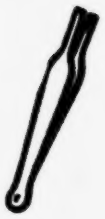
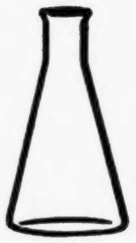
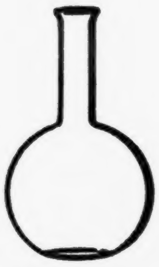
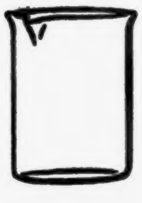
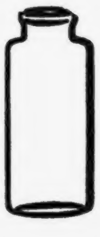
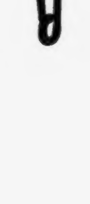
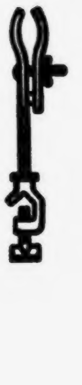
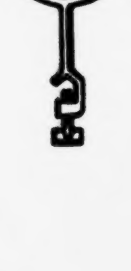
During the year you will spend part of your class time in the laboratory observing first hand what happens to living and nonliving things when you change the conditions around them. You will then try to explain what you have seen and how it relates to the world around you.

During this time you will be using apparatus and materials that you probably have not seen or handled before. Some of these pieces of apparatus are simple and inexpensive; some are complex and costly. Some of the material is completely safe to handle; some must be handled with care. Your careful preparation for and attention to each exercise if very important to your learning, and for your safety and that of your classmates.

The next page shows some of the equipment you will need. You will use more items than are shown here, but these are the most common. Write the name of each item below it. You should learn to recognize each one, refer to it by its correct name and understand what it is used for. You will receive more complete instructions regarding the use of each piece of apparatus as it is required.

Read carefully the sheet titled "Important Rules for Laboratory Work," and keep it available for reference during each laboratory period.

Science Laboratory Equipment

Important Rules for Laboratory Work

I. Orderliness

A. Arrange the materials you will need for a particular experiment in an orderly fashion. Orderliness avoids confusion and waste of time.

B. Label all materials on their containers so you will be able to identify them.

C. After use, return laboratory material and equipment to its proper place.

D. At the end of the working period, leave your working space in order.

II. Cleanliness

A. After use, wash glassware and instruments with cleaning powder, or cleaning solution and rinse in clear water. Dry the metallic materials and place glassware on drying rack.

B. Clean the sink after use. Avoid disposing of any refuse in the sink. Wrap refuse in paper towels and place it in the waste basket.

C. Wipe off work tables and sink tables with sponge or damp paper towels.

III. Care of instruments and apparatus

Much of the laboratory apparatus is expensive. Exercise great care with its use. "Playing around" has no place in a laboratroy. One careless slip may result in the loss of valuable material and possible personal injury.

IV. Performance of work

A. Read in advance the daily assignment of exercises and arrive at class prepared for the work. You will usually need the entire laboratory time for testing and making observations.

B. Wear your safety glasses when any danger to eyes exists, whether from your action or that of your neighbors.

C. Always observe good safety practices. Do not attempt any experimentation that is not in the instructions or approved by your instructor. Personal injury or damage to clothing and other property can easily occur if directions are not followed, or if a student is careless.

D. Observe all instructions carefully. For example, "One minute" in the laboratory instructions means one minute measured by the second hand on a watch or clock. Only by accurate performance can accurate results be obtained. Work not done accurately is only wasted effort.

V. Record keeping

Accurate record keeping is one of the most important phases of your work. It is imperative that records be made at the time of observation. Simple drawings may be important parts of records. Often "a picture is worth a thousand words." Develop the skill of making clear drawings

VI. Reports

Complete your laboratory report as soon as possible following the laboratory period, so that all of the details will be fresh in your mind. Consider all of the data you have gathered and your previous knowledge of science, as you prepare your report. Be prepared to discuss the laboratory exercise in class. Make certain that each laboratory report is completed accurately, neatly and on time.

Measurement and Observation - Teacher Information

This exercise is a modification of a similar exercise contained in the 1961 BSCS-Blue Version Biology paperback text to which you may wish to refer. In addition to observing an important natural phenomenon, it is designed to familiarize the student with the elements of a controlled experiment, techniques of measurement using the metric system, and interpreting acquired data.

The students should be given preliminary instruction in the use of the metric ruler and the triple beam balance, and shown how to read a graduated cylinder. Safety precautions and techniques in the use of the cork borer should also be demonstrated.

An excellent programmed student exercise on making and reading graphs may be found in the BSCS Biological Science, Patterns and Processes, 1966, pp. 9-44. Copies of this book should be available at your school from the biology department, the library, or the teacher(s) of Basic Biology 1-2.

Materials:

	Source
3 or 4 fresh, white potatoes	
razor blades (single edge)	Biology or Custodian
Cork Borers (1 cm.diameter)	Chemistry
Distilled Water - 100 ml/team	Biology or Chemistry
*5% sucrose (table sugar) solution (50 grams sucrose per liter of solution)	Biology
*10% sucrose solution - 100 ml/team (100 grams sucrose per liter of solution)	
Triple beam balances	Biology or Chemistry
250 ml. beakers (3 per team)	Biology or Chemistry
10 ml. graduated cylinder (1 per team) (a disposable inoculating syringe without a needle will substitute.)	Biology or Chemistry
dissecting needles (1 per team)	Biology

Some discussion of the process of osmosis will follow the investigation, however, a detailed explanation may be deferred until the units on living things. This exercise provides the teacher with opportunities to discuss the value of repeating experiments since the individual results will vary. An average of all of the reported results should give a more accurate picture. Such terms as distribution, mean, median and mode which are introduced in the book may be discussed here.

*5% and 10% salt (Na Cl) solutions (use same formula for making solutions) may be substituted for or used as a comparison for the action of the sugar solution.

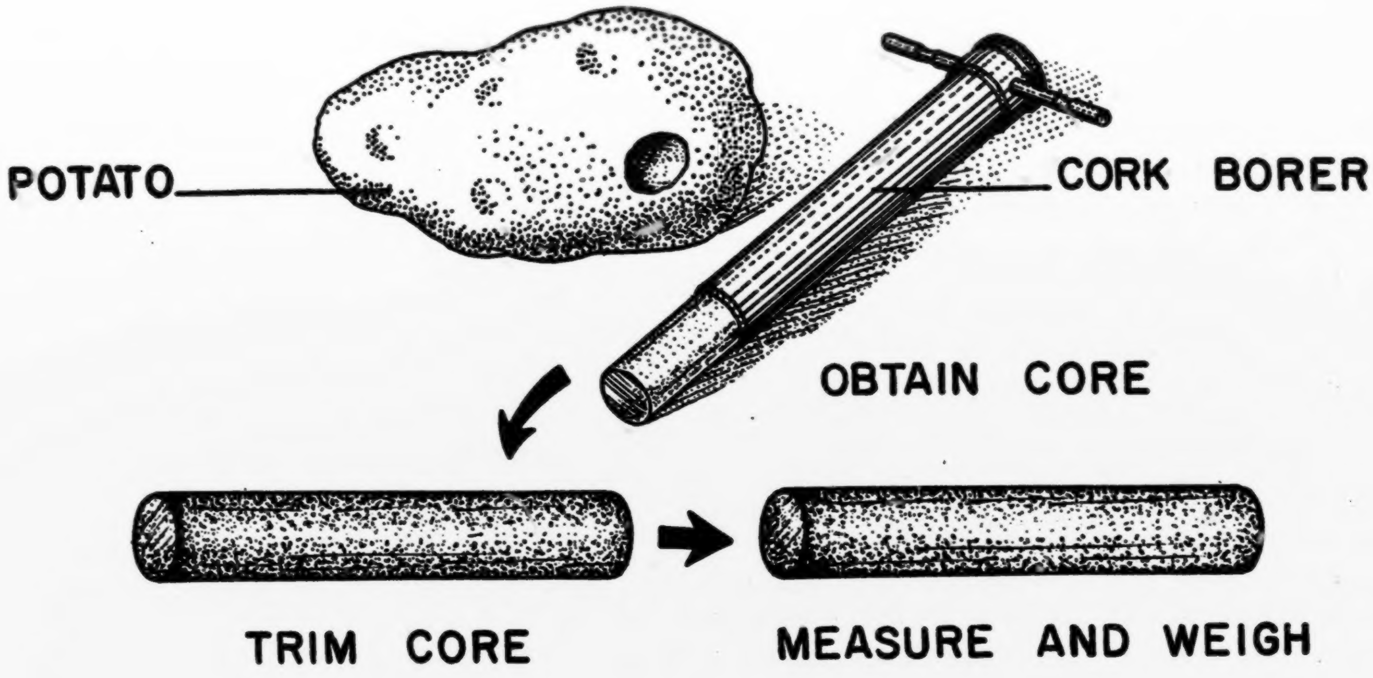
EXERCISE NO.___________ NAME_________________

Measurement and Observation

In this exercise you will use a metric ruler, a triple beam laboratory balance and a graduated cylinder for measuring demensions, weight and volume. The data will be recorded in metric units. You will also observe a process that is very important to all living things.

Remember that following directions carefully, measuring accurately and keeping accurate records are very important in science.

1. Using a cork borer, cut three cores from a fresh, white, potato (see diagram). Trim these with a razor blade so they are of equal length--about 4 cm. Carefully measure the length and diameter of each to the nearest millimeter. Record the measurements in the data chart.



Preparation of the potato core.

2. Pour 4 to 6 ml (milliliters) of water in a graduated cylinder. (1 ml = 1 cubic centimeter, abbreviated cc). Record the measurement of the water level: ______________. Place the core in the graduated cylinder, then using the dissecting needle hold the core entirely submerged in the water. Measure and record the water level: ____________ The difference in the two readings (the amount of rise of the water) is the volume of the potato core. Record the volume on the data chart.

3. Place a small piece of clean paper on the tray or pan of the balance. Weigh the paper: __________ Blot the excess water from the core, place it on the paper on the balance and weigh to the nearest hundredth of a gram: ________. Subtract the weight of the paper to determine the weight of the core. Record the weight of the core on the data chart. Place this core in a beaker containing about 100 ml of distilled water and label it solution "A".

4. Following the same procedure as above, weigh and measure another core, place it in a beaker of 5% sugar solution labeled solution "B".

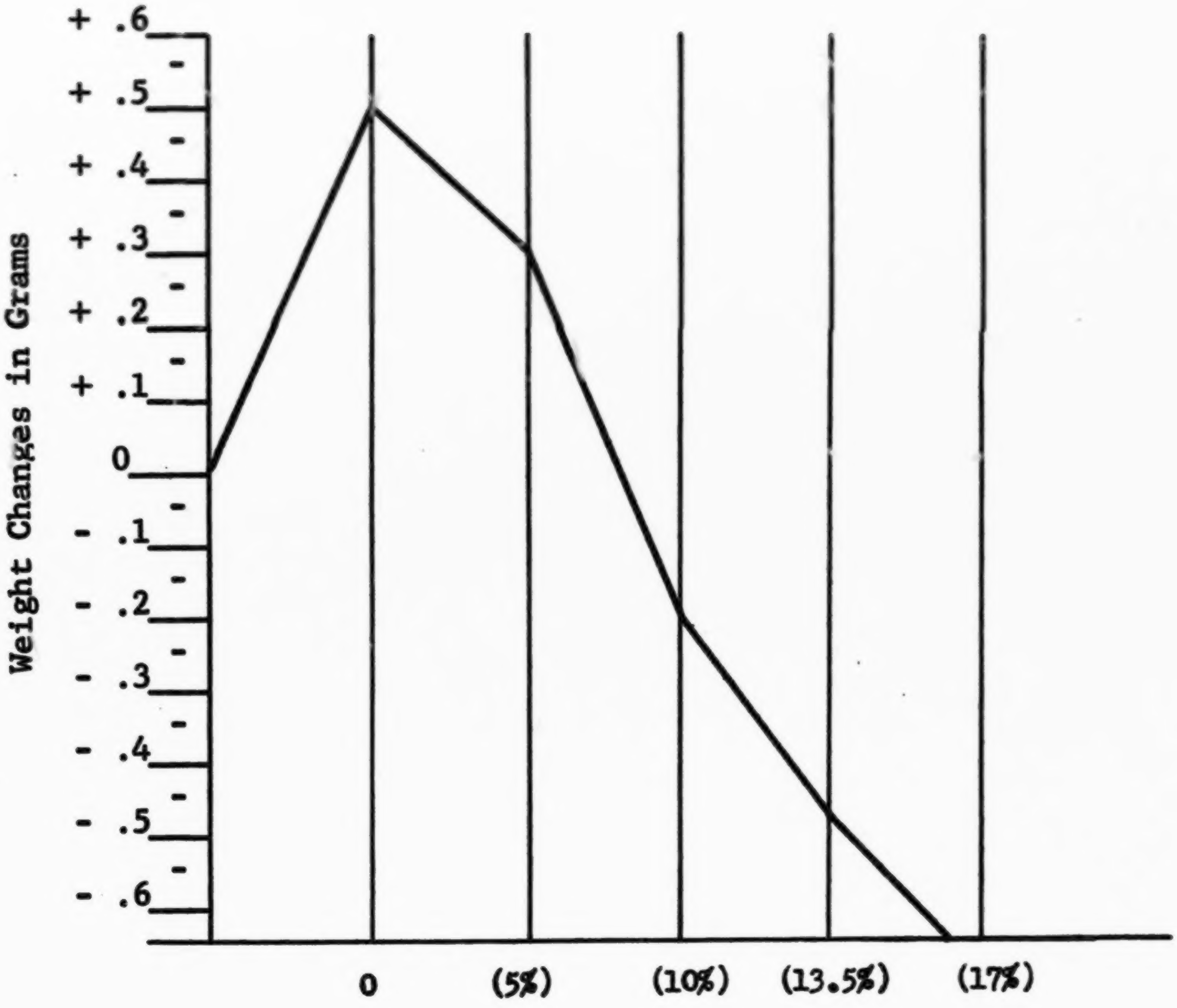
5. Place the third core (after weighing and measuring) in a 10% sugar solution labeled solution "C". Cover each with waxed paper or foil and let them stand over night.

DATA CHART - EXERCISE

Measurement taken	Core in solution "A"	Core in solution "B"	Core in solution "C"
Length	Original___ Final______ Difference_____	Original___ Final______ Difference_____	Original___ Final______ Difference_____
Diameter	Original___ Final______ Difference_____	Original___ Final______ Difference_____	Original___ Final______ Difference_____
Circumference	Original___ Final______ Difference_____	Original___ Final______ Difference_____	Original___ Final______ Difference_____
Volume	Original___ Final______ Difference_____	Original___ Final______ Difference_____	Original___ Final______ Difference_____
Weight	Original___ Final______ Difference_____	Original___ Final______ Difference_____	Original___ Final______ Difference_____

6. On the following day remove each core from the beaker; measure the length, diameter, weight, and volume in the same manner as before. Record these data. Compute the differences between the data for Day 1 and Day 2.

7. Data are not of much use unless they can be interpreted. Following is a graph made from the data taken from a similar experiment. Insert the information you obtained in your experiment on this graph. Record your data honestly, even if it does not agree with this sample graph.



GRAPH 1 Sugar Solution

8. Look at the data you obtained, and study the graph very carefully. Check also to see if there is a difference in the rigidity of the cores. Do you see a relationship between the solutions and the change in weight of the core? Write down any relationships you see. If you are having difficulty, look up the term osmosis in your text or in a reference book.

Observations:

Conclusions:

Changes in Matter: Physical and Chemical Changes - Teacher Information

This exercise should be done near the end of chapter two. Pages 45 and 46 of chapter three should be assigned as preparatory reading. The laboratory exercise is intended to increase the student's understanding of the differences between physical and chemical changes. He should be lead to realize that changes similar to these, some imperceptible, others quite spectacular, are responsible for all of the changes in things that happen.

Materials:	Sources:
Woods metal, one tiny pellet per team	Chemistry
Small test tube, 2 per team	
Large test tube, 1 per team	
Graduated cylinder, 1 per team	Chemistry or Biology
Sugar, sucrose, small amount	Chemistry or Biology
Spatula, 1 per team	
Platinum or nichrome wire, (wire supporting the filament in a light bulb will work very well)	Chemistry or Biology
Copper wire, 12 or 14 gauge, 3-4 in lengths, 1 per team	Chemistry
Forceps	
Test tube holder	
Bunsen burners	
Magnesium ribbon, 1-2 cm. lengths, 1 per team	Chemistry
Ammonium dichromate, small amount	

Comments:

Part I: Unless the student is watching carefully he may not observe that the Woods metal has liquified in boiling water.

Part 2: Because of the danger of spilling, you may wish to demonstrate for the class the chemical action of concentrated nitric acid on Woods metal.

Part 3: The spatula refers to the small spatulas (Nonstock SPA-5220) used in semimicro chemistry. If these are unavailable, a "spatulaful" would correspond to a volume approximately equal to that of an aspirin tablet. Tasting should involve the smallest amount required to identify the material.

Part 4: It is not intended that reagents and products of the chemical reactions involved be explored in detail. The students may be lead to realize that heating copper in presence of air produces copper oxide, and burning magnesium produces magnesium oxide. Burning the ammonium dichromate should be recognized only as a chemical change because of the altered appearance. (The primary reaction is $(NH_4)_2 Cr_2O_7 \longrightarrow N_2 + 4H_2O + Cr_2O_3$.)

EXERCISE NO. ____________ NAME ________________

Physical and Chemical Changes

Matter all around us is constantly undergoing changes. In Chapter two you learned about the three states of matter--solids, liquids and gases and how solids may be changed to liquids and liquids to gases. How would you change lead (solid) to a liquid? ____________ How would you change liquid water to a solid (ice)? ____________ If you then let the liquid lead and the ice stand for a while at room temperature they will change back to their original state. These are examples of physical changes.

In the exercises which follow you will observe other examples of physical changes and a different kind of change called chemical change.

1. Put 1 ml. of water in a small test tube and heat the water to boiling. Put a piece of Woods metal about the size of a BB shot into the boiling water. Carefully observe and describe what happens to the metal.

   ____

   Cool the test tube by allowing cold water to run around the outside of the tube. Remove the metal. Examine and describe it.

   Did the metal undergo a physical change? ________________

   Explain your answer. ________________________________

   ____

2. Next place the piece of Woods metal in a small test tube and add 10 drops of concentrated nitric acid. The gas that is given off is slightly poisonous so do not allow the reaction to continue too long.

   Explain how this action differs from the above action of Woods metal and hot water. ________________________________

   Has the metal undergone a seemingly permanent change, producing a new chemical? __________ If so, a chemical change occurred.

3. Place a clean spatulaful of sugar in a clean small test tube containing about 1 ml of water. Taste the resulting solution (cautiously).

   Does the change in appearance of the sugar change its taste? ________

   Do you think a new chemical was produced? __________ Which of the two kinds of changes occurred? ____________________

   Heat a drop of the above solution on a clean glass slide (cautiously pass the slide back and forth over the flame) until dry. Describe the taste and appearance of the residue. ____________________

____

Which type of change occurred? ______________________

4. Examine a piece of platinum wire. Observe its flexibility and luster. Heat the wire to redness in the flame of the burner and note its appearance. Let the wire cool and again examine its properties.

   When platinum wire is heated, is the change physical or chemical? ____

5. Repeat the experiment in "E" using a piece of bright copper wire. Compare the properties of the copper wire before and after heating.

   How does the surface of the copper change in appearance? __________

   Does the copper return to its original appearance? ______________

   Which type of change occurred? ______________________

6. In chemical changes one or more new substances (chemical) are formed. Also, when chemical changes occur heat is usually either absorbed (endothermic) or given off (exothermic).

   Name a device that produces electricity as a result of a chemical change. ______________________________________

   Name a chemical change that gives off heat. __________________

   With a forceps hold a piece of magnesium ribbon about 1 cm long in the burner.

   How does the new substance differ from the original metal? What has the magnesium combined with? __________________

   Name this compound that is formed from burning magnesium. ______

   Write a word equation for the reaction. __________________

   ____

   Write what evidence you have noticed of a chemical change and point out whether energy is involved in the reaction. ________

   ____

   Heat 1 spatulaful of ammonium dichromate in a large, dry test tube. When the reaction begins, withdraw the tube from the flame and allow the product to fall on a piece of paper.

   Record your observations. ______________________

   ____

Which type of change occurred? ______________________

Is there evidence of energy? ________ Is it absorbed or given off? ______________________________

Write down how a chemical change may be distinguished from a physical change.

____

____

Elements, Compounds and Mixture - Teacher Information

It is intended that these exercises will help the students to understand the differences between elements, compounds, and mixtures, as well as provide further insight into physical and chemical changes. Either of the exercises, I or II would probably require most of one class period.

Materials (I):	Sources:
Fine white sand, small amount	Chemistry or Biology
Hand lens, 1 per team	Biology
Spatula, 1 per team	Chemistry
Sugar, small amount	Chemistry or Biology
Test tubes, small, 1 per team	Chemistry or Biology
Wood splints	Chemistry or Biology
Bunsen burners	Chemistry or Biology
Mercuric oxide, small amount (1-2 oz.)	Chemistry

Comments (I):

Part 1: To separate the sand and sugar the students may suggest separating it particle by particle, which, though quite correct would be quite time consuming. Many of the students will recognize the obvious and dissolve the sugar in water and pour it off.

Part 2: The students will need prior instruction in the technique of testing with glowing splint. The demonstration may be done with only air in the test tube and of course, with negative results. Pyrex test tubes should be used for heating the mercuric oxide. Students should be cautioned that a "vapor" produced by heating the mercuric oxide (they will probably recognize it later as mercury) is poisonous and the heating should be confined to the amount necessary to observe results.

Part 3: The students will probably need some assistance in classifying the substances. They are not expected to know at this point that sand is silicon dioxide or that sugar is an organic compound although heating the sugar in a previous experiment may help them. They may need help in relating the igniting of a glowing splint to oxygen, but will probably recognize the mercury droplets on the inside of the test tube.

Materials (II):	Sources:
Spatulas, 1 per team	Chemistry
Triple beam balances	Chemistry or Biology
Sulfur (powdered) small amount	Chemistry
Iron (powdered or filings)	Chemistry
Carbon disulfide (optional)	Chemistry
Funnel, 1 per team	Chemistry or Biology
Filter paper, 1 per team	Chemistry or Biology
Test tubes, 2 per team	Chemistry or Biology
Beaker or evaporating dish, 2 per team	Chemistry or Biology
Dilute hydrochloric acid, (dropper bottles)	Chemistry

Comments (II):

The students should be lead to recognize that if materials can be separated mechanically it is a mixture and that only when a chemical change has occurred and new substances formed would a compound be produced.

Part 1: The use of carbon disulfide is optional. If used it should be used in a well-ventilated room to avoid concentration of the fumes so that danger of fire and of damage from inhalation of the "rat poison" is reduced. Some odor may be produced by the HCl in the mixture, however, the odor of hydrogen sulfide gas is unmistakable.

Part 2: If the powdered iron is used rather than iron fillings, better chemical reaction will take place. This will be noted especially when checking the iron sulfide for attraction to magnet. Complete reaction and thus a completely nonmagnetic material is unlikely.

Part 3: Students may have little basis for classifying sulfur and iron (unless guided to the periodic chart of elements) but it is hoped that they will be able to classify the heated and unheated sulfur and iron combinations.

EXERCISE NO. ______________ NAME ____________________

Elements, Compounds and Mixtures, - I

In the following exercise you will see the kinds of things that must be true about materials so that we may say that they are: (1) an element, (2) a compound, or (3) a mixture. Sometimes it is not possible to tell the difference without very careful chemical testing. As you do this exercise you will try also to tell if a chemical or a physical change has taken place.

1. On a piece of paper, mix several spatulasful of fine, white sand with an equal portion of sugar. Using a hand lens or magnifying glass see if you can tell the difference between the particles of sugar and sand. Is this an element, a compound or a mixture? ____________________

   Suggest several ways of separating the sugar and sand. ____________________

   If your instructor approves of your methods, try one of them. Describe your method and your results. ____________________

   Were the changes physical or chemical? ____________________

2. Carefully heat two spatulasful of red mercuric acid in a pyrex test tube until you see a definite change in the mercuric oxide. Test the gas inside the test tube with a glowing splint. Results: ____________________

   Scrape around the inside wall of the test tube with a clean wood splint to see the material adhering there. Describe: ____________________

   What is the material? ____________________

   Is red mercuric oxide an element, a compound, or a mixture? ____________

   Why do you think so? ____________________

   Would you classify the gas which was produced and the material deposit on the test tube elements, compounds, or mixtures? ______________. Was this a physical or a chemical change? ______________

3. Complete the following chart:

Material	Element, Compound, or Mixture?	Evidence
Sand		
Sugar		
Sand plus sugar		
Red Mercuric Oxide		
Product #1 ________		
Product #2 ________		

EXERCISE NO. ____________ NAME ________________

Elements, Compounds and Mixtures - II

In this exercise you will see the kinds of things that must be true about materials so that we may say that they are: (1) an element, (2) a compound, or (3) a mixture. Sometimes it is not possible to tell the difference without very careful chemical testing. As you do this exercise you will try also to tell if a chemical or a physical change has taken place.

1. On a piece of paper, mix thoroughly several spatulasful of powdered sulfur and an equal amount of powdered iron.

   a. Place one third of this material in a test tube and add 3 ml. of carbon disulfide. (Carbon disulfide is flammable, keep away from flames!) Shake and filter the mixture. Pour the filtrate (the liquid that has passed through the filter) into a beaker and set it in a well-ventilated place so the carbon disulfide can evaporate. Observe later and record your observation here. ________________________________

   b. Place one third of the material in a test tube and add 5 drops of dilute hydrochloric acid. Is an odor produced? ____________ Compare any odor to that produced in a later part of the experiment.

   c. Use a magnet and try to separate the remaining one-third of the material. Results ________________________________

   d. Do you think an element, a compound, or a mixture was produced when the sulfur and iron were combined in this way? ____________ Why? ________________________________

   e. Was a chemical or a physical change involved? ____________

2. Weigh out accurately 1.4 grams of powdered iron and 0.8 grams of sulfur. Mix the iron and sulfur completely on a piece of paper, then pour them into a small test tube.

   a. Heat the tube carefully in the flame until it begins to glow, then withdraw the tube from the flame and observe. ____________

   b. Break the tube by allowing a few drops of water to fall on the hot test tube. Remove the material inside and test it with a magnet. Results ________________________________

   c. Try to dissolve some of the material in carbon disulfide. Results ________________________________

   d. Put some of the material on a 50 ml. beaker and add a few drops of dilute HCl and observe the gas produced. Describe ____________ How does it compare to the odor produced in A2 above? ____________

e. Was a chemical or a physical change involved? ____________________

3. Complete the chart below.

Material	Element, Compound, or Mixture?	Evidence
Sulfur		
Iron		
Sulfur & Iron (no heat)		
Sulfur & Iron (heated)		

EXERCISE NO. ________________ NAME ______________________

A STUDY IN CLIMATE

Purpose

To compare the average monthly temperatures of different cities of the United States.

Procedure

1. On a sheet of graph paper, prepare a graph from data given in the table below. Use a different colored line for each city.

Month	Atlanta, Georgia	St. Louis, Missouri	San Francisco, California	Duluth, Minn.	Juneau, Alaska	San Diego, California, (1965)
January	44	33	50	10	29	56
February	46	36	53	13	29	56
March	53	45	54	24	34	59
April	61	56	55	38	40	61
May	69	66	57	49	47	63
June	76	75	59	58	54	64
July	78	80	58	65	56	68
August	78	78	59	64	55	72
September	73	71	61	56	50	69
October	63	60	61	45	44	69
November	62	46	57	28	36	75
December	45	36	51	15	30	83
Yearly	62.0	57.0	56.7	39.2	42.5	62.6

Questions

1. Which cities have relatively constant average monthly temperature? How can you tell?
2. What do you know about their locations that might explain this?
3. Which city has the greatest range of average temperatures?
4. What do you know about its location that might explain this?
5. The yearly average temperatures for St. Louis and San Francisco as recorded on the chart are very nearly the same. Look at the average monthly temperature graphs for these two cities and explain why this is true.
6. Do the graphs show anything about the maximum and minimum daily temperatures?

Water - Teacher Information

This exercise was designed to assist the teacher in showing the students some of the characteristics of water and emphasizing how intimately involved it is with their everyday lives.

Materials:

Tap water
Distilled water
Sea water, several gallons
(Artificial sea water may be made by following the formula: Add 27 g. of sodium chloride, 3.5 g. of magnesium chloride, 1.8 g. of magnesium sulfate, 1.2 grams of calcium sulfate and 0.9 g. of potassium sulfate in a 1 litter graduated cylinder and add sufficient water to make a total of one liter.)
Soda straw, ½ per team
B-B's (or copper shot, Nonstock COP-5005), one or two per team, Chem, Phys
Glue, several containers (GLU-BIRD, Elmers or other glue not readily water-soluble) Custodian
125 ml beakers, 3 per team
25 ml graduated cylinder, 1 per team
150 x 20 mm test tubes, 3 per team
Medicine dropper, 1 per team
Soap solution, chemistry teacher may have some or follow directions on page 108 of text (TRY THIS). Be sure that detergent is not used to make the solution as results will be significantly different.
Watch glass, 3 per team, Bio, Chem

Comments:

Part 1: The students should observe a significant difference in the number of drops of soap solution necessary to produce suds in the distilled water and the tap water. They will probably be unable to produce suds in the ocean water.

You may demonstrate the relative ease of producing suds in distilled water and tap water using detergent and discuss the fact that certain minerals (Ca^{++} and Mg^{++} ions) react with the soap to produce scum, but not with the detergent. A discussion of advantages and disadvantages of using detergent may logically follow to include effect on clothes, skin and difficulty of breaking them down in the sewage systems. Use some zeolite to soften the tap water and retest for production of suds.

Part 2: The soda-straw hydrometers will not show a measurable difference in the densities of the distilled water and tap water, but the difference in density of these and the sea water should be easy to discern.

You may use a commercial type of hydrometer (Nonstock HYD-4000) to measure the differences in density more precisely. Specific gravity bottles (Nonstock SPE-1000) may also be used to demonstrate this.

Part 3: If this part of the exercise is set up by the students on the day prior to the exercise, it would provide greater continuity. The students will probably be surprised at the quantity of residue from the sea water and the tap water. This part of the exercise should facilitate discussion of the water cycle, of solutions, soils in poorly drained regions, formation of salt lakes, etc.

EXERCISE NO. ____________________ NAME ______________

Water

Water is a substance with which we are all quite familiar. In this exercise you will compare distilled water, tap water and sea water to see some of the ways in which they differ.

1. Take one-half of a soda straw, put enough glue in one end to seal it. Imbed a B-B in the glue and set it aside for the glue to dry.

2. Pour 100 ml of tap water into a 125 ml beaker, 100 ml of tap water into another and 100 ml of sea water into a third. Taste each sample of water in the above order by putting a drop or two on your tongue. Describe the taste. Why should you taste them in the order suggested?

3. Use the graduated cylinder to measure 25 ml samples of each of the three types of water into separate test tubes. Label the test tubes indicating their contents. To the test tube containing distilled water, add soap solution drop by drop, counting the drops and shaking the test tube well after each drop until about one-half inch of suds remains on top of the water. Record the number of drops needed to produce the suds. Test the tap water and then the sea water in the same manner.

Type of Water	Drops of Soap Solution
Distilled	
Tap	
Sea	

Does San Diego tap water produce soap suds easily? ____________ What would be some of the advantages in treating the tap water so it would suds as easily as the distilled water?

Would sea water be good for washing clothes and dishes?

4. Place the soda straw with heavy end downward into the beaker of distilled water. If it will not float upright in the beaker, add a little weight inside the straw (a few straight pins or possibly another B-B). You now have a simple hydrometer.

Make sure the straw is not touching the bottom or the sides of the beaker. Make a pencil mark on the straw at the water line. Make similar marks on the straw when it is in the tap water and also in the sea water. In which type of water did the soda straw sink deepest? Why is there a difference in the depth the straw sinks?

How does the draft of a ship in water change as it goes from the Atlantic Ocean into the Great Lakes?

How would it change in the Great Salt Lake?

5. Use a clean medicine dropper to measure ten drops of each kind of water into three separate watch glasses. Label the watch glasses to indicate the kind of water it contains and set it in a warm place for the water to evaporate. After it has evaporated (it may be the next class period) carefully observe the residue and describe what you see.

What happened to the water that you placed in the watch glasses?

How is this related to the "water cycle" in nature?

Does San Diego City water contain dissolved minerals? What happens to the salts that are dissolved by the river waters flowing over rocks and earth on its way to the ocean?

Is the ocean becoming more or less salty? ________________

(Optional) Obtain some silver nitrate from your instructor. Place a few drops of the silver nitrate into each of three test tubes containing 10 ml of distilled water, tap water and sea water. Describe what you see and then find out the cause.

Use and Care of the Microscope - Teacher Information

The student will probably not have many opportunities to use the microscope, either in this course or in later life. He should, however, develop an appreciation for the instrument by finding out how much it will magnify objects and how a scientist is able to use it to reveal otherwise unavailable information.

Materials:	Sources:
Microscope, one per two students	Biology
Slides, one per team	Biology
Cover glass, one per team	Biology
Dissecting, needle, one per team	Biology
Medicine dropper or pipette, one per team	Biology or Chemistry
Scissors, one per team	
Newspaper	
Cloth - nylon, cotton, wool	
Lens paper	

The amount of familiarization involved in this exercise should not be attempted in a single class period. Probably part of one day should be spent discussing the first part of the exercise including the diagram, learning the nomenclature, demonstrating the use of the microscope by the teacher and even carrying it to the laboratory tables and studying the instrument itself.

The instructor should be prepared to give information as to which, if any, of the microscopes are not parfocal.

EXERCISE NO. ____________ NAME ____________________

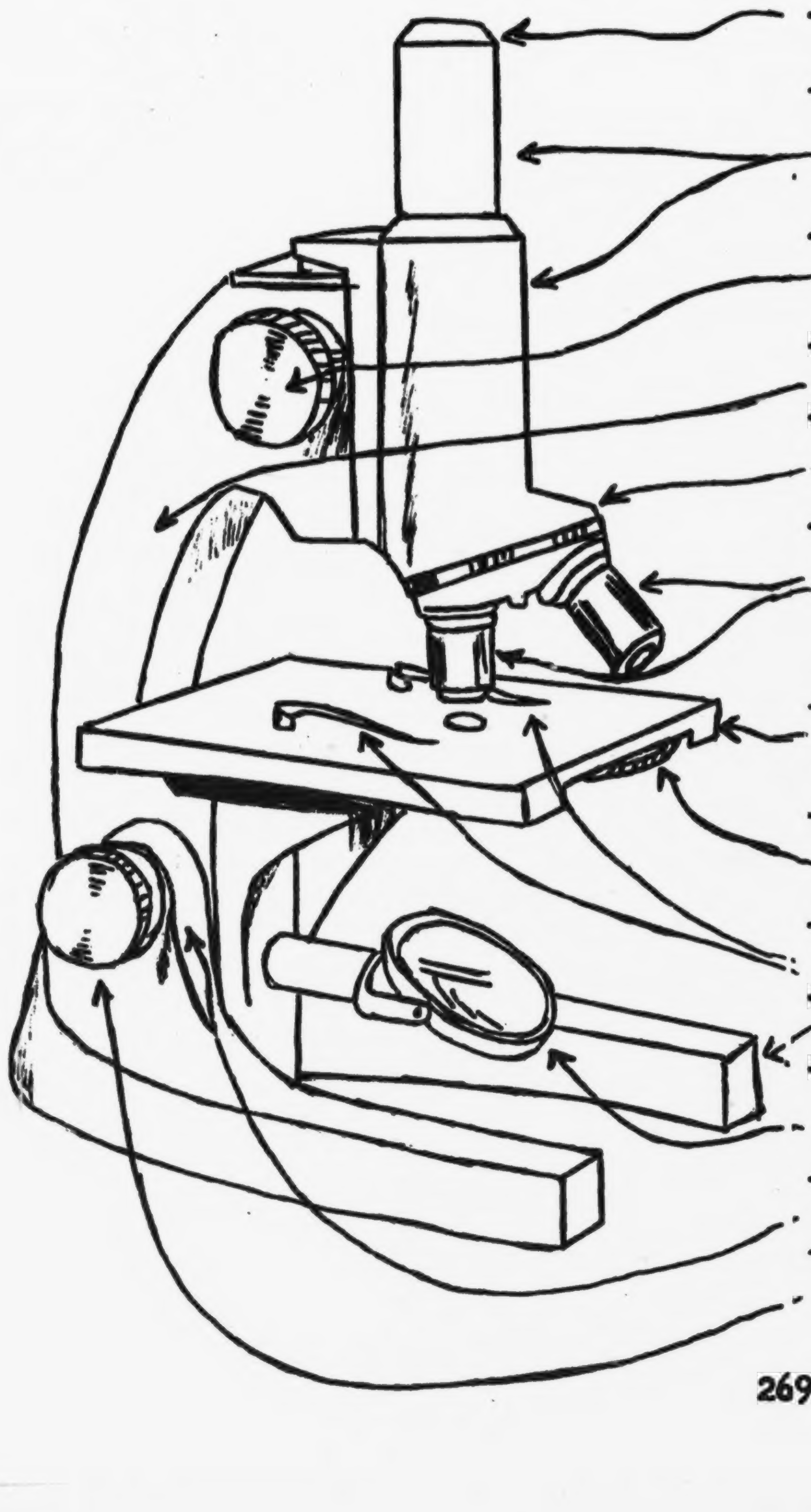
Use and Care of the Microscope

The microscope is an instrument designed to help the scientist examine very small objects. Using the microscope can extend your sense of sight so you can see what is otherwise invisible. The microscope you will use will enlarge these objects as much as 430 times.

The microscope is one of the most expensive items you will be using. You should study carefully and learn all you can about its care and use. In this way you will be able to use it more effectively without being fearful of damaging it.

Study the diagram of the microscope and become familiar with each part and its purpose. Learn the names of the parts.

The Microscope



-OCULAR
Contains lenses to increase magnification.

-BODY TUBE
Holds lenses of ocular and objectives at the proper working distance from each other.

-COARSE ADJUSTMENT
Moves body tube up and down approximately to the correct distance from the specimen.

-ARM
Supports body tube and coarse adjustment.

-NOSEPIECE
Permits interchange of low and high power objectives

-OBJECTIVES
Contain lenses of different magnifications; here the shorter low power objective is 10X, the longer, high power objective is 43X.

-STAGE
Supports slide over hole that admits light from mirror below.

-DIAPHRAGM
Regulates amount of light passing through the specimen.

-STAGE CLIPS
Hold specimen slide firmly in place.

-BASE
Firm support bearing weight of microscope.

-MIRROR
Reflects light upward through diaphragm and hole in stage.

-INCLINATION JOINT
Permits titling to adjust to eye level.

-FINE ADJUSTMENT
Permits exact focusing by moving stage or body tube up or down very slightly.

Setting up the Microscope

1. Use both hands for carrying the microscope. Hold the arm with one hand and place the other hand under the base. Set the instrument down gently on the table, with the base several inches from the table's edge.

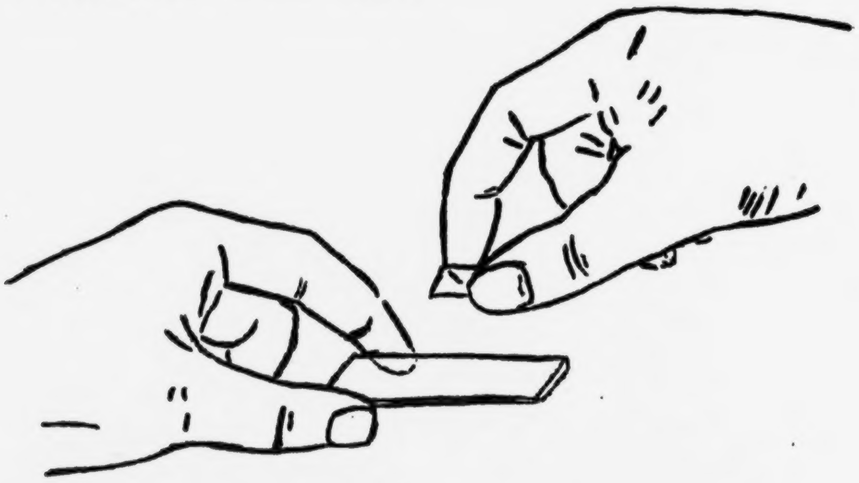
2. Rotate the nosepiece so that the low powered objective (the shorter one) is in line with the body tube. It should click or snap into position.

3. Look through the ocular and adjust the mirror until it reflects light upward through the opening in the stage. (Some microscopes have a substage illuminator).

4. Still looking through the ocular, adjust the diaphragm so that the round field of view is evenly illuminated, without glare.

5. If the ocular or objective is cloudy or dusty, wipe the lenses gently in one direction with a piece of lens paper. Do not use any other kind of paper or cloth. Use a piece of lens paper only once.

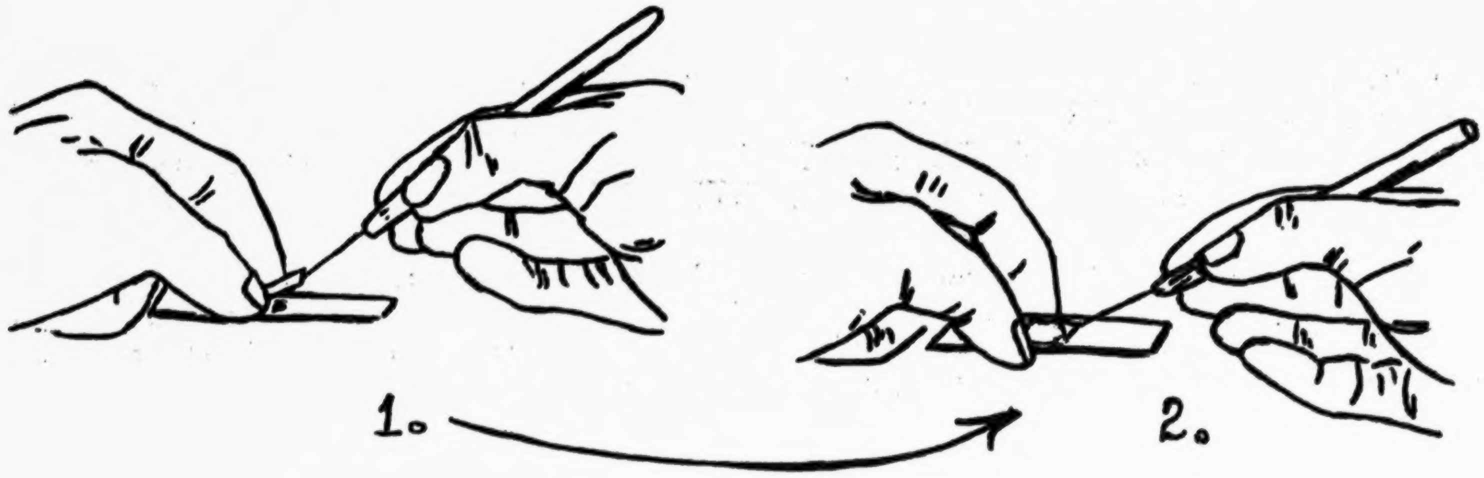
Preparing materials: Materials to be studied under the microscope are placed on a glass microscope slide. The material on the slide is covered with a smaller and thinner piece of glass called a cover glass. Always hold slides and cover glasses by their edges.



Handling Slide and Cover Glass

1. Cut a 1 cm. square piece of newspaper bearing fine print on which the small letter "e" appears.

2. Place the piece of newspaper on the center of the slide. With a medicine dropper or pipette put a drop of water on the piece of paper. Wait a moment and add another drop of water. Then cover with a cover glass by holding the cover glass at about a 45° angle to the slide with a dissecting needle as illustrated, and slowly lowering it. Gently tapping with the eraser end of a pencil will remove any bubbles present. You now have a wet mount.



Placing Cover Glass on Wet Mount

3. Place the slide on the stage with the letter "e" right side up, and clamp it down with the stage clips. Move the slide so that the "e" is over the middle of the hole in the stage.

4. Make sure the low-power objective is in place. While viewing the stage from the side, use the coarse adjustment knob to lower the objective until the stop is reached, or until the objective nearly touches the cover glass. (See further directions in item 5, part 5.)

5. While looking through the ocular, use the coarse adjustment knob to raise the objective until the printed letter comes into view. With the fine adjustment knob make the focus as sharp as possible. What is the position of the letter "e" as seen through the microscope? ____________ Move the slide away from you. Which way does the "e" move? ____________________

Prepare another wet mount, this time using a small piece of nylon or other cloth. Observe the cloth under low power following the instructions given above.

Find out from your teacher whether your microscope is parfocal (both high- and low-power objectives are adjusted to the same focus). If not, see the special instruction below. If so, rotate the nosepiece so the high-power objective snaps in place over the slide, and while viewing through the ocular sharpen the focus.

If your microscope is not parfocal (1) center the material to be viewed in the field of vision under low-power (2) raise the objective with the coarse adjustment knob (3) rotate the nosepiece so the high-powered objective snaps in place. (4) While observing from the side of the microscope, lower the objective until it is almost down to the cover glass. (5) While viewing through the ocular slowly rotate the coarse adjustment knob until the material is in focus, (6) sharpen the focus with the fine adjustment knob. Repeat steps 3 through 6 if the material does not come into view. Never lower the objective toward the slide with the coarse adjustment unless you are observing its distance from the side.

Does the change from low to high power change the position of the image in the field of view? ____________ Does the field of view show a larger or smaller area of the object? ________________ Is the brightness of the field greater or less than with the low power? ________________ Adjust the diaphragm to provide an even illumination without glare.

The cloth is thicker than the paper with the letter "e" so you may rotate the fine adjustment back and forth slowly to get a three-dimensional picture of the cloth: length, width and also depth. If time permits, you will find it interesting to look at fibers of cotton, wool, and human hair.

Plant Structures - Teacher Information

This exercise affords the student opportunity to observe some of the structures of plants that he has read about and discussed previously. He should relate the structure and function by his observations. This exercise will probably require about $1\frac{1}{2}$ class periods, using the $\frac{1}{2}$ class period the first day.

Materials:	Sources:
Beakers, 125 ml. or 250 ml., 4 per team	Biology or Chemistry
Razor blades, 1 per team	Biology or Custodian
Hand lens, 1 per team	Biology
Food coloring, red (any dark color will work) 1 bottle or more	Biology or Direct Purchase
Celery, 3 stalks per team plus some extras for controls	Direct Purchase
Microscope, 1 per team	Biology
Microscope slide, several per team	Biology
Cover glass, several per team	Biology
Stain (methylene blue) optional	Biology
Triple beam balances, several	Biology or Chemistry
Salt (NaCl)	Biology or Chemistry
Bunsen Burner	Biology or Chemistry
Ring and Stand	Biology or Chemistry
Wire gauze	Biology or Chemistry

In preparing the celery only the tops, with about 15 cm. of stem, need be provided to the students.

Be sure to keep some controls (1) in plain water, (2) left in the room dry from one day to the next.

On observing the celery stalks on the second day, the students may not notice the color changes until they are compared to the controls.

The difference in rigidity of the two halves in different solutions will be easily observed. The students may relate this phenomenon to the difference in rigidity observed in the potato cores in laboratory exercise on measurement and observation in Chapter 1.

Students may notice immediately the color in the fibers of the part of the stalk "c" that was originally cut off, but may not otherwise notice the color in the fibers until they have cut off the end. They may relate the fact that there must be a connection between all of the fibers somewhere. They should discover where this is when they make sections where the branching takes place.

The xylem fibers will tend to be loosened from one another by boiling and also the helical coils which make them will tend to loosen and they will see this structure more easily. You may wish to have them stain some of the fibers to facilitate observation.

You may wish to relate the practical use of similar fiber for cloth, ropes, etc.

EXERCISE NO. ______________ NAME ____________________

Plant Structures

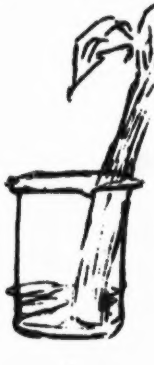
Most of the green plants with which you are familiar carry on life processes that are alike. The various plants often look quite different but have parts which are quite alike in how they look and what they do. We say that their structures and functions are similar. In this exercise you will observe some of these structures and try to relate their functions to them.

1. Your teacher will provide your group with 3 celery stalks. Draw a picture of one of them and describe it as to color, shape, size, rigidity. Write down also any parts (that you can see) of the leaves or stems that carry on some of the functions you have already studied.

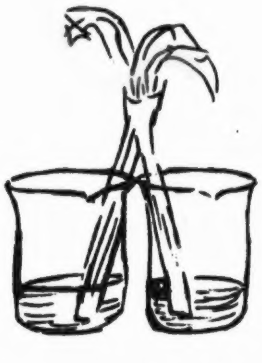
   What seem to be some of the important functions of the celery stem?

2. Pour water to a depth of 6 cm. in a small beaker. Add red food coloring to make a strongly colored solution. Divide the solution evenly in 3 beakers. Using a fourth beaker, make a 5% salt solution by adding 5 grams of salt to 100 ml. of water. If there is more salt solution than there is food coloring solution in each of the other beakers discard the excess.

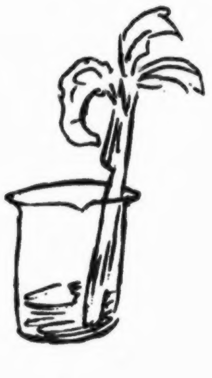
   a. Place a celery stalk in one of the beakers of food coloring solution. See diagram A.
   b. Split another celery stalk for a distance of about 6 cm. from the base. (Use the razor blade and carefully split it equally distant from each side.) Place a beaker of food coloring solution by the beaker of salt solution and put one side of the celery stalk in each solution. See diagram B.
   c. Split the remaining celery stalk in the same manner as in b. but cut off one of the sides. See diagram C. Place this stalk in a food coloring solution.



A



B



C

Period 2.

3. Without removing the celery stalks from their containers observe any changes that may have taken place. Describe them.

4. Remove celery stalk "A" from its solution. Compare it to some celery stalks that your instructor has (1) kept in water, and (2) left in a dry container since the last period. How do they differ? Give reasons for the difference.

5. Remove celery stalk "B" from its solution. Compare the two sides of the stem as to color and rigidity. Give reasons for the difference. How does this remind you of the potato cores observed early in the year?

6. Remove celery stalk "C" from its solution. Compare it to the other stalks. Cut off about 1 cm. of the base and look at the end with the hand lens. Can you tell how materials pass up through the stem? Draw a picture of the end.

7. Using the razor blade, cut as thin a slice as you can off the end of the stock and prepare a wet mount slide. Try several slices and use the thinnest one - it need not be a complete slice. Use the low power on the microscope and observe several places. Be sure to look carefully at the spots that have been colored. Draw pictures of what you see. Did you observe any places where materials might move downward from the leaves?

8. Continue to cut sections of the stalk until you get to the region where the stalk branches off. Then cautiously cut off thinner sections. The spots will change to streaks of dye (food coloring). Prepare another wet mount of a thin section and draw pictures of what you see.

9. Remove a long colored fiber from one of the stalks. Cut it into 1 cm. long pieces (at least 6). Take one of the pieces and prepare a wet mount. Before you look at the slide, lay it flat on the table, press down with your thumb on the cover slip and twist to spread the parts of the fiber. Draw a picture of what you see under low power. Put the remaining five pieces of fiber into a beaker of boiling water. Each two minutes for ten minutes remove one piece from the beaker and prepare a slide as before. Draw pictures of what you see.

10. Consider all of the observations you have made; what do you think the fibers are like before they are boiled? What does boiling do to them? What are these fibers called?

Measurement of Heat Produced by Burning Fuel - Teacher Information

Student understanding of the kinds of foods necessary for energy, growth, and maintaining a healthy body is essential. This exercise offers an opportunity to see the relationship between the kind of food and the heat or caloric content. This exercise is similar to the BSCS-Biological Science: Patterns and Processes, 1966 edition (laboratory activity S-37-38, pp. 78-80).

Materials:	Sources:
Tin can calorimeter, 1 per team - (check with your Basic Biology teacher) Frozen juice can or equivalent is recommended. You may have students make them prior to class with tin snips, hammer and nail. The hole necessary to accept the tube may be made by cutting with a knife and bending the edges in.	
Corks, small, 1 per team	Biology or Chemistry
Test tube, pyrex, 13 x 100 mm	Biology or Chemistry
10 m. graduated cylinder, 1 per team	Biology or Chemistry
Thermometer, centigrade, 1 per team	Biology or Chemistry
Needle, 1 per team	
Matches, liberal supply	Biology or Chemistry
Walnuts, 3 pieces per team	Prior to this experiment have several students weigh out samples of walnuts and peanuts. Suggested weight is 0.20 grams. Larger samples may cause boiling and invalidate the experiment. Careful weighing should be observed. Have extra pieces available.
Peanuts, 3 pieces per team	

Students may experience some difficulty in burning their samples, but with persistence will get some satisfactory results.

The students will not get results that agree with the calorie chart. Discussion as to why readings are lower, such as heat loss, incomplete burning, etc., may follow. Suggestions for improving apparatus may be invited. The need for supplying sufficient quantities of air to the burning nut may be explored. Correlating the data from all of the students would probably be beneficial to show the value of such activity.

Other discussion suggestions.

1. Energy requirements vary for different activities and conditions.

2. Large amounts of energy may be acquired from small amounts of food.

3. Unused food is stored in the body.

EXERCISE NO. ______________ NAME ____________________

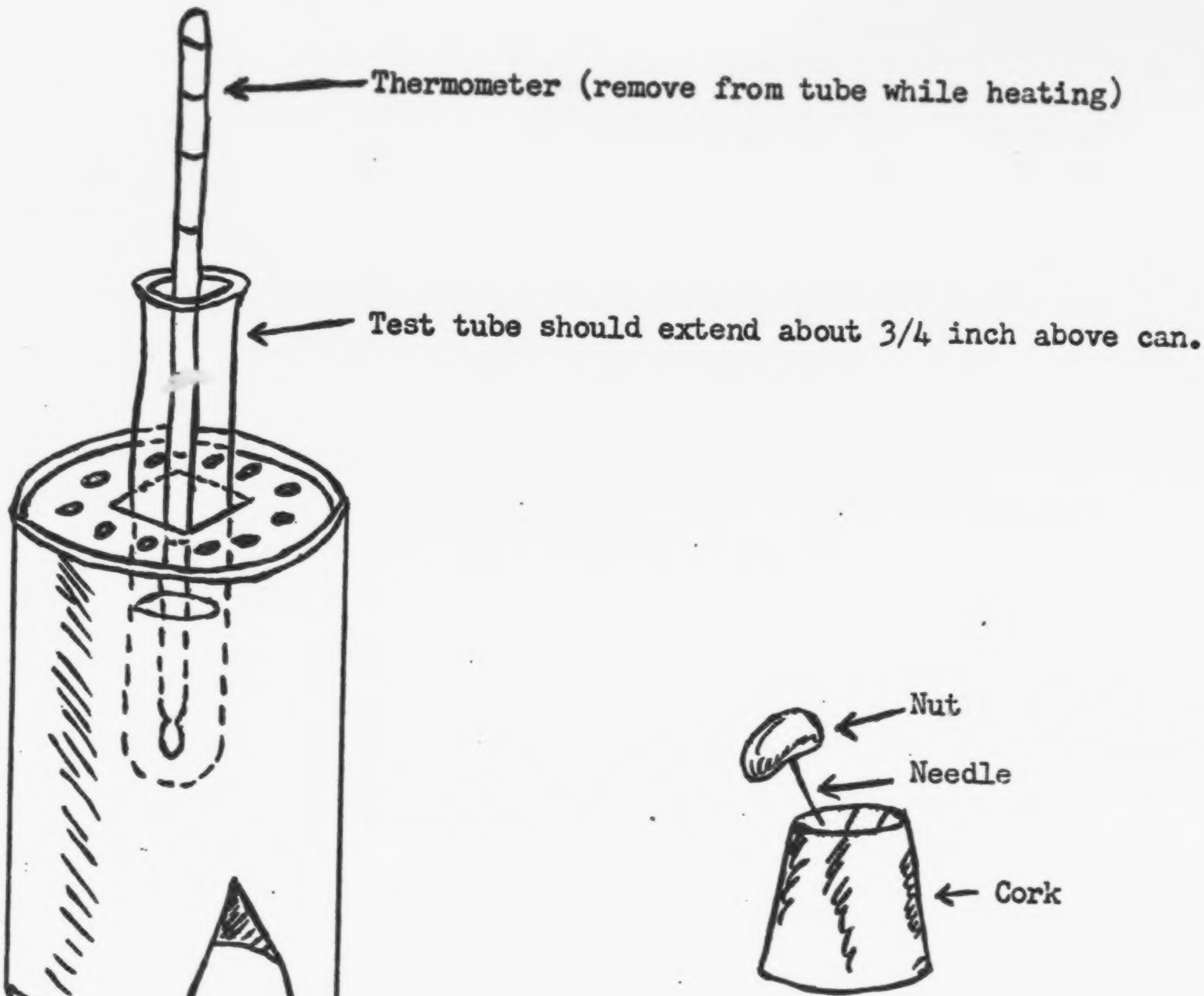
Measurement of Heat Produced by Burning Food

You have learned that one of the things our body needs is energy. We get most of our energy when our cells "burn" sugars and starches but we may also use fats and proteins as fuels.

The amount of heat given off by foods when they are burned is measured in units called calories. These are the same calories that diet-conscious people talk about.

In this exercise you will measure the amount of heat produced by two foods - walnuts and peanuts. Do the exercise carefully. Be sure to burn each piece of nut in the same way each time.

1. Assemble the equipment as shown in the figure.


Thermometer (remove from tube while heating)
Test tube should extend about 3/4 inch above can.
Nut
Needle
Cork

Calorimeter

2. Measure 8 m. of water and place in the tube. Measure the temperature of the water, and record it on your table. Remove the thermometer before proceeding to the next step.

3. Ignite the nut and place it immediately under the test tube. Burn the nut to an ash. Should the fire sputter and go out, reignite the nut. If this problem persists, punch a few more holes in the top of the can. This will allow more air to reach the fire to keep it burning. Discard the partially burned nut, refill the tube, and start over with a new piece. In fact, whenever in doubt, do it over. What would be the reason for this procedure?

   After each piece of nut has burned completely, measure the temperature of the water and record it on your table. Repeat the procedure for three pieces of walnut and three pieces of peanut. Find the average of the temperature differences. Why should you average the differences?

Substance	Trial	Temp. at Beginning	Temp. at End	Difference of Temp.	Average Temp. Difference
Walnut	1				
	2				
	3				
Peanut	1				
	2				
	3				

Calculating the Calories

Scientists have agreed that a calorie equals the amount of heat necessary to raise the temperature of 1 ml. of water 1 degree centigrade. This is called a simple calorie and is spelled with a lower case c (calorie). When one talks about calories in food, we use a kilocalorie which means 1000 simple calories and is spelled with a capital C (Calorie).

Transfer data collected to the table below and multiply wherever necessary.

Example: If temperature of 8 ml. of water went up 5 degrees, you multiply 8 x 5, which gives you 40 calories.

In other words, if each ml. of water rose 5 degrees (5 calories) and you have 8 ml. of water (5 x 8), 40 calories of energy were used.

To calculate kilocalories, divide the simple calories you have by 1000.

Example: If you have 40 simple calories, you have 40/1000 Calories or .04 Calories.

Data Chart 1

Substance	Average Difference	No. of ml.	Simple calorie	Kilocalorie
Walnut				
Peanut				

The following information comes from a Calorie Chart. Calculate the number of calories per gram for peanuts and walnuts. Compare the results you gathered with it.

Data Chart 2

Nut	Weight in Grams	Food Energy in Calories	Calories per Gram
Almond, shelled	36 (1/4 cup)	213	
Coconut, shredded	8 (2 Tablespoons)	43	
Peanut, roasted, shelled	36 (4 Tablespoons)	210	
Peanut Butter	16 (1 Tablespoon)	90	
Pecans	15 (12 halves)	100	
Walnuts	16 (8-12 halves)	100	

To show you how many Calories of energy a high school student needs in order to do a particular exercise, the following table is included.

Calories Used in 1 Hour of Activity

96 Calories

Sitting

300 Calories

Walking

426 Calories

Tennis

In Data Chart 2 you saw that one tablespoon of peanut butter provides 90 Calories of energy. How much peanut butter would you need for one hour of sitting? ______________ Walking? ______________ Tennis? ______________

You can see that you can do much activity with a very small amount of food. What happens to fuel that is not used immediately by the body?

The Circulatory System - Teacher Information

This exercise is designed to familiarize the student with the structure and function of the circulatory system. It will probably require more than one class period to complete the exercise, and it is suggested that the investigation of the circulatory system of the fish be conducted during the last half of one class period, and the investigation of factors affecting the pulse rate be performed on the following day.

Materials:	Sources:
Half-slides, two per team	Biology
Cotton, amount depends upon size of fish	Biology
Fish (goldfish or guppies)	Biology or Direct Purchase
Microscopes, one per team	Biology
Petri dishes, one per team	Biology
Dip net, several	Biology
Timer with sweep secondhand, one	Biology, Physics or Chemistry

The students should have little difficulty in locating the blood vessels in the fish, and, with a little assistance, they will be able to identify the arteries, the veins, and the capillaries. There may be some difficulty with the fish tails flopping, but the weight of the half-slide will probably be sufficient to minimize this.

The portion of the exercise which concerns the pulse rate should be approached with some caution. Any student with physical disability should be excused from any violent exercise. Care should also be exercised in the discussion that students whose pulse rates vary considerably from the normal do not become unnecessarily alarmed.

Suggested modifications of this portion of the exercise may be (1) after norms are established, to take the class out to the track and keep close records of pulse rate variations of athletes in peak condition compared to students not presently participating in sports. Be sure to include controls and note that the onlookers pulse rate also increases significantly, or (2) to bring a phonograph and some records to the classroom and, after norms are established, play popular records with different tempos and note the effect on the heart rate. Several students may demonstrate a popular dance, and the pulse rate of the participants and the spectators analyzed.

You may suggest that if any of the student's parents or friends smoke cigarettes, they might compare their normal pulse rate to their pulse rate while smoking. This, of course, would have to be done at home and reporting may be optional.

Recording the high and low pulse rates for each kind of activity would be interesting, with an approximation also of the average rate for the entire class.

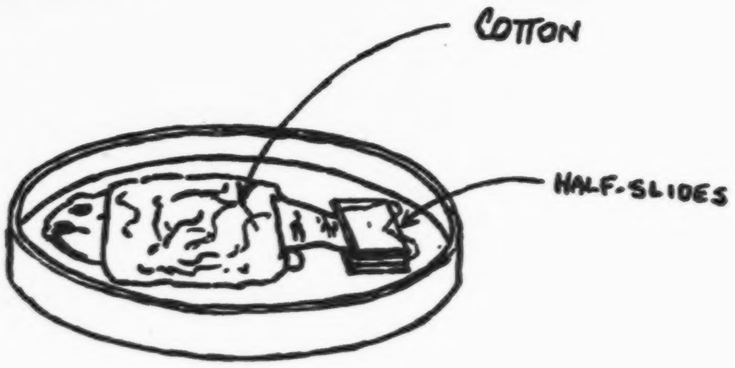
Students should recognize that the increase in pulse rate is designed to pump greater volumes of blood providing oxygen for, and removing carbon dioxide from, cells that are being exercised.

EXERCISE NO. ____________________ NAME ____________________

The Circulatory System

This exercise should help you to understand the circulatory system and how it relates to the rest of the body. You will observe the circulation of the blood in a living animal, and later observe the effect of certain activities on the pulse rate.

1. Secure a goldfish or a guppie from your instructor. Wrap it loosely in wet cotton, leaving the mouth and tail exposed. Place it in a petri dish so there is a half-slide under and a half-slide over the tail of the fish as in the illustration. Drop water on the cotton and on the tail from time to time so the fish will not be injured.



2. Remove the microscope stage clips, place the petri dish on the stage, and focus on the tail with low power. If you observe near the posterior edge of the tail, you will see blood flowing through the blood vessels.

   a. Find some small arteries and veins and diagram them. How can you tell which is an artery and which is a vein?

   b. Find some capillaries and draw part of the network of capillaries.

   c. Where does the blood flow most rapidly - in the capillaries, arteries, or veins? Why?

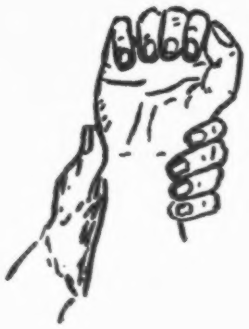
d. Describe any differences you may see in the walls of the three types of blood vessels.

e. Observe a capillary network for several minutes. Does each capillary carry blood continuously? Describe the rate of flow of red blood through the capillaries.

f. List the services that the blood provides for the body.

3. We usually think of the presence or absence of heartbeat as determining whether a person is alive or dead. The rate at which the heart is pumping the blood is of interest to a doctor as a way of telling how a person is responding to medication or recovering from surgery, etc. The heart rate is usually found by "taking the pulse." This may be done by feeling the surge of blood go through an artery each time the heart beats. This is usually done by touching a finger to a place on the wrist where arteries are close to the surface. Arteries are usually farther from the surface than veins. Why?

4. One method of finding your pulse is to hold your right wrist in your left hand as in the diagram. Feel for your pulse with your middle finger. Have your partner count your pulse for 30 seconds and determine your pulse rate while you are sitting at your desk. Record your pulse rate in beats/minutes on the chart. Find and record your pulse rate under various circumstances as indicated on the chart.



Activity	Pulse Rate
Seated	
Standing	
Running in place for 5 seconds	
1 minute after above activity	
2 minutes after above activity	
Running in place for 10 seconds	
1 minute after above activity	
2 minutes after above activity	

5. Try to get at least four other readings under circumstances you may decide for yourself and then make a graph of your results. List the activities along the horizontal axis in order from lowest pulse rate to highest rate, with the pulse rate along the vertical axis. Compare your graph with that of several of your friends to see how alike or different they are.

Does every person have about the same normal pulse rate? ____________

What was the highest in your class? ____________

What was the lowest in your class? ____________

How does exercise affect the pulse rate?

What determines how long it takes the pulse rate to return to normal?

In addition to exercise, what else will affect the pulse rate?

In what way is increasing the pulse rate helpful to the body?

Force, Acceleration, Velocity and Momentum - Teacher Information

This exercise was adapted from the PSSC (1965 ed.) Experiment III-7. Using this exercise the class should gain a greater understanding of forces, acceleration, velocity, and momentum.

Materials:	Sources:
Dynamics carts, 2 per team	Physics
Meter sticks, 1 per team	Physics
Tables, with wood bumpers, installed as in the diagram, 1 per team, tables should be approximately 160 cm. between bumpers.	
Bricks, 5 per team	Physics
Hammer or wood block to trigger cart, 1 per team	

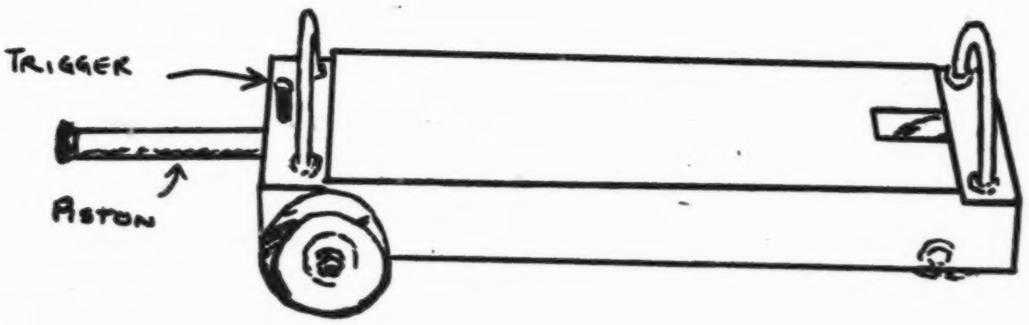
All of these materials should be available from the physics teacher, including the wooden bumpers and the "C" clamps. Each brick was designed to have the same mass as a cart. The tables should be level for greatest accuracy. The students will probably anticipate the answers to questions two and three, however, they should perform these steps anyway. It will be obvious that there is a relationship between the mass and the velocity as the experiment; however, most of the students will not realize what this relationship is until they answer (or begin to answer) the last three questions. It should be emphasized that with each setup the force applied is equal in both directions. (It may vary somewhat from one setup [cart] to the next.) The final velocity varies with the mass. The total momentum (zero) should be conserved. Discussion of reasons for slight variations from this (friction, was table level?) should be pursued, or if large disagreements occur, they should be rechecked. Some students may be interested in finding out if the kinetic energy is the same in both directions.

EXERCISE NO. ______________ NAME ____________________

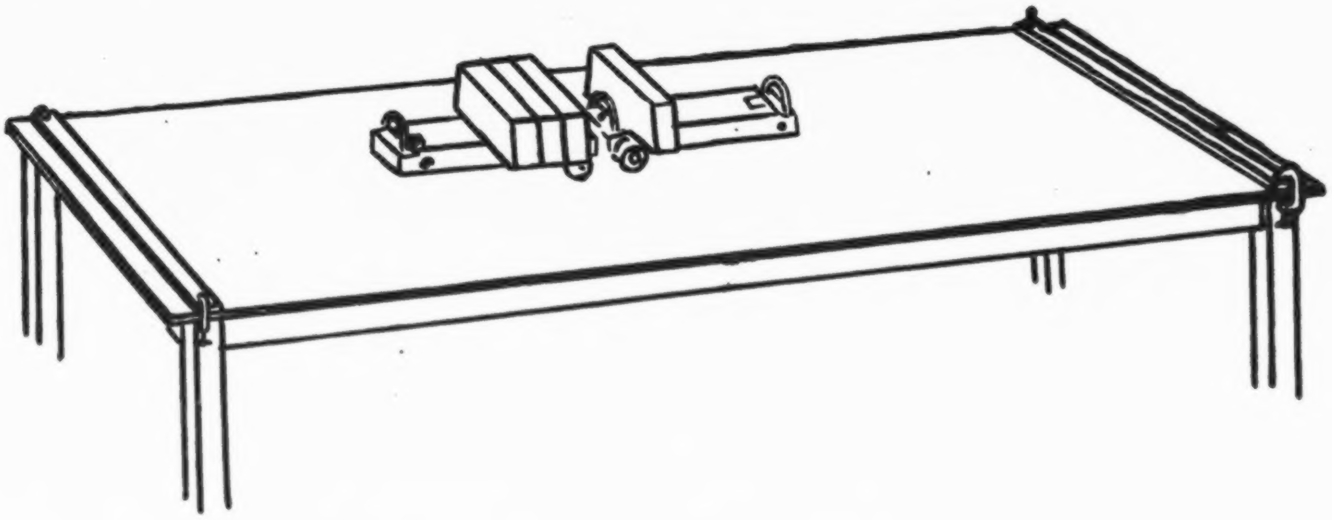
Force, Acceleration, Velocity and Momentum

You have learned that forces may be used to do work, and that a continually applied force may be used to accelerate, or constantly change the velocity of an object. You will be working with dynamics carts to study some of the laws of motion.

Carefully observe the dynamics cart so that you will understand how it operates. CAUTION: Do not release the trigger when your eyes are near the piston.



1. Cock the cart, and release the piston by tapping the trigger with a hammer or a piece of wood. Why not push the trigger down with your hand?
2. Set the cart in the middle of the table and trigger it empty, and with one, and with two or more bricks. What is the result?



3. Place a second cart next to the first so that the spring will push against the second cart when released. What happens as you release the spring?

4. Place different numbers of bricks on the carts and release the springs. Does the velocity of a cart seem to have a relationship to the number of bricks it carries? Explain.

5. Place the two carts end-to-end half way between the two bumpers (measure accurately). Release the trigger. Do the two carts hit the bumpers at the same time? ________ Practice listening for the impacts of the carts so you can tell if they are at the same time. Carefully measure the distance each cart must travel. Record the distance on the chart.

	Bricks	Distance Traveled
Setup 1	1 (cart only)	
	1 (cart only)	
Setup 2	1 (cart)	
	2 (cart plus) one brick	
Setup 3		
Setup 4		
Setup 5		
Setup 6		

6. On one of the carts place a brick. Experiment to find exactly where you must place the carts so that they hit the bumpers at the same time. Measure the distance each cart must travel. Record the distance on the chart. Also record the number of bricks. Count the cart itself as "one brick" as in setup 1 and setup 2 on the chart. Determine the distance involved with the cart opposed to a cart plus two bricks and record your results. Try three other combinations of your choice and record the results.

7. In each setup, which travels farther to get to the bumper, the cart with the lighter or heavier load? ____________________

8. In each setup, which takes the longer time to get to the bumper? ________
Right! You arranged it so they would take the same amount of time.

You may remember that the distance anyone travels depends upon how fast he is going (velocity) and how long he is traveling (time) so, distance = velocity x time. Since the time is the same in each setup the distances traveled by each cart is different only because of its velocity. For your calculations you may then use the distance traveled to represent the velocity. Use the number of "bricks" (1, 2, 3, etc.) to represent the mass.

9. For each setup, make another column to the right and multiply the number of bricks (mass) times the distance traveled (representing velocity) and you will have the momentum of each cart. mv = momentum

10. Compare the momentum in each direction for each setup.

11. Scientists say we can find the total momentum in a situation like this by subtracting the momentum in one direction from the momentum in the other. What is the result if you do this for each setup?

Heat Production and Transfer - Teacher Information

This exercise is designed to investigate: (1) the relationship of the three essentials of a fire and (2) heat conduction. The students should be familiar with pages 325-336 in the text. Controlling the amount of fuel (or eliminating it completely) is not developed in the exercise and deserves some mention. Students may have some difficulty in recognizing that the hottest part of the flame is not in the inside cone but in the oxidizing portion of the flame.

You may wish to demonstrate the use of the conductometer (Nonstock CON-0220) which may be in the physics department, and have the class graph the relative conductivity of the materials involved.

Materials:	Sources:
Burner, 1 per group	Chemistry or Biology
Matches	
Wood splints	Chemistry
6 to 8 inch length of glass tubing, 1 per group	
Large nail, 1 per group	Custodian, workshop
6" length of copper wire, 12 or 14 gauge, 1 per group	

EXERCISE NO. ____________ NAME ________________

Heat Production and Transfer

The Bunsen burner is the source of heat most commonly used in the laboratory. You have used it before, but probably have not studied it carefully. If you learn how a burner works and how to control it, you will better know how to use and control all kinds of fires.

1. Carefully examine the construction of the Bunsen burner.

   a. How can you control the amount of air entering the burner? ____________

   ____

   b. What is the purpose of the barrel on the burner? ________________

   ____

   c. Draw an outline of your burner showing all the parts and labeling them.

2. To light the burner, first light a match, then turn on the gas and hold the match near the top of the burner. Be very careful at all times to keep your face, hair, clothing and other combustible material away from the flame.

   a. What are the three "essentials" of a fire? ____________________

   ____

   Which "essential" does the match provide? ____________________

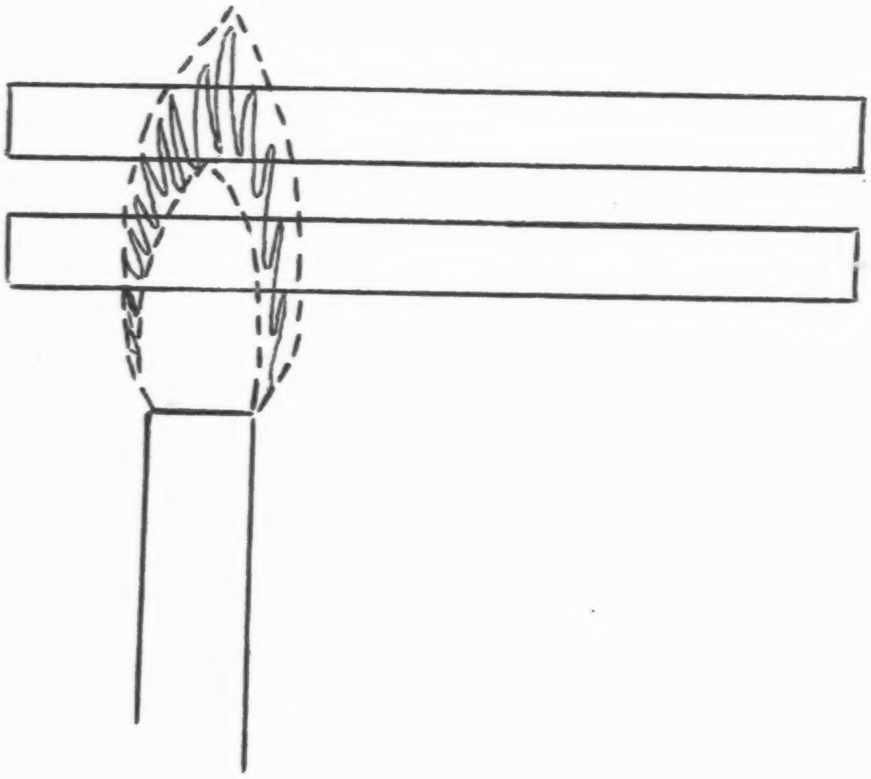
   b. Describe the two kinds of flame which are obtained by changing the amount of air allowed to enter the burner. ____________________

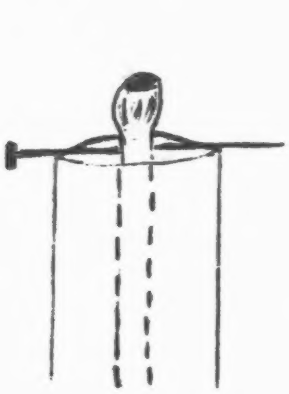
   ____

   c. Which flame is hotter? ______________ Why does controlling the amount of air effect the temperature of the flame? ______________

   ____

   d. Adjust the burner to produce the hotter flame. Hold a wood splint in the flame for a second or two in various places and try to determine where the hottest parts of the flame are by observing the charring. (See illustration.) Push a pin into an unlit match near the head and place it in the unlit burner. Light the burner with another match. Make a diagram of the flame labeling the hottest and less hot parts.





3. What methods of heat transfer can you observe in working with the burner?

____

4. Using some glass tubing, copper wire, nails, wood splints, try to determine how well these materials conduct heat. Be very cautious about handling these materials when they may be hot as they may have the same appearance when hot and cold. Place these materials on an asbestos pad or wire gauze to protect the counter top when you set them down.

5. With a forceps hold a small square of wire gauze or metal screen about an inch above a lighted Bunsen burner for a few seconds. Describe and explain the effect on the flame.

6. Predict what would happen if a lighted match were held above a metal screen about an inch above an unlighted Bunsen burner.

____

____

Explain: ____

____

Summarize what you have learned about burning and heat transfer:

____

____

____

____

The Eye and Vision - Teacher Information

This exercise is designed to help the student understand the structure and the function of the eye and the part the brain plays in vision.

Materials:

Flashlight or lamp - several will be sufficient since students may alternate their use.
Cardboard, 8" x 6" - 1 per team
Sheet of paper - 1 per team

This exercise should be done after the students are somewhat familiar with the anatomy of the eye.

EXERCISE NO. ____________ NAME ________________

The Eye and Vision

Vision depends upon two things: (1) the reaction of the eye to the light that reaches it and (2) the way the brain interprets what the eye sees. This exercise will help you to understand more about the structure of the eye, how it operates, and the part the brain has in seeing.

Work with a partner. You will use both yourself and your partner as experimental subjects. If you wear glasses, you may have to remove them for parts of the exercise.

1. Have your partner close his eyes and cover them tightly with his hands for 30 seconds. Then have him open them and uncover them while you watch closely his pupils and his irises. What do you see? ________________

   ____

   Repeat, reversing roles with your partner. What is the value of the reflex you have observed? ________________________________

   ____

2. Have your partner hold a cardboard vertically along his nose and between his eyes. Shine a light into his left eye while observing the pupil and iris of his right. Repeat, reversing eyes. Then repeat reversing roles. Describe the results and explain.

3. While observing your partner's eyes have him look through the windowpane at a distant scene. Then have him look at a speck on the same pane. Describe what you see. ________________________________

   ____

4. Hold your forefinger about 8 inches from your nose. Close first one eye and then the other. Repeat several times. Describe and explain. ______

   ____

5. The part of the retina where the optic nerve leaves it has no rods or cones. You cannot see with this part, so it is called the blind spot. Hold the diagram below directly in front of your right eye, and focus that eye on the cross. Close the left eye. Although you are looking at the cross, the circle will also be in your range of vision. Move the diagram away from and toward your eye and find the spot where the circle disappears. Repeat the procedure with the left eye. Explain. ________________

   ____

Why don't we ordinarily notice the blind spot? ______________________________

____

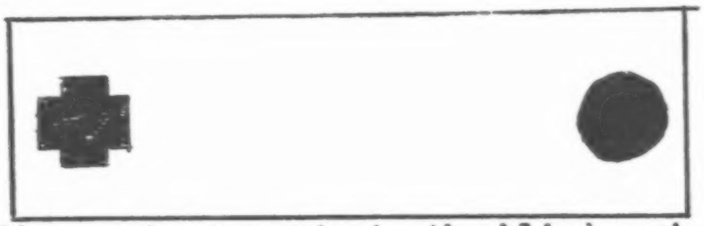


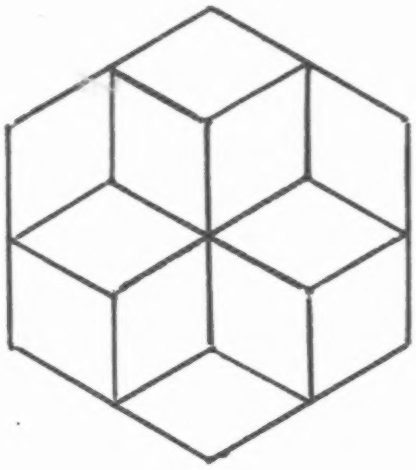
Diagram to demonstrate the blind spot

6. Most people use one eye more than the other. They call that eye the dominant eye. You can identify your dominant eye. Using a sheet of paper, make a tube one or two inches in diameter. Look at some object across the room, then raise the tube at arms length so you are looking through the tube at the object. Holding the tube steady, close first one eye and then the other. Which is your dominant eye? ______________ How do you know? ____

7. With one hand, hold the tube close to one eye. Hold the other hand several inches in front of the other eye. Do you see a hole in your hand? _____ Explain. ____

8. Looking for a long time at a bright light or at bright colors tires the retina. After such activity, we see after images. Have your partner time this activity. Look at a bright light or a bright picture for 20 seconds, then at the wall or ceiling. Describe the afterimage. ______________ How long does it last? ____

9. Look at the diagram below for 30 seconds. What do you see? ____________ Explain. ____



10. Try to classify each of the results in 1 through 9 above as to whether it is a: (1) response of the eye to light, or (2) an interpretation of the brain or (3) neither.

Electricity and Magnetism--Teacher Information

This exercise is designed to familiarize the students with the properties of magnets and the relationships between electricity and magnetism.

Materials:	Sources:
Dry cell, 1 per team,	Physics
Wire, copper, insulated, small gauge, spool	Physics
Compass, magnetic, (Stock 29-C-5800 or 29-C-5815), 1 per team	
Ring and Stand, 1 per team	Physics
Bar magnet, 2 per team	Physics
Iron filings, small quantity per team	Physics or Chem
Bolt or Iron Bar, about ¼ inch diameter, 1 per team	

Comments:

Caution the students not to attach both ends of the wires directly to the cells as they should only be connected for very short periods of time. They should be held to the terminal, the observation made, and then withdrawn. Students may be afraid of being shocked, but need not be. Iron filings may be in a "shaker" to facilitate sprinkling. Caution the students against getting filings directly on the magnets as they are difficult to remove. Magnets with an acetate sheet over them, and iron filings may be used to demonstrate parts 1, 2, and 3 of the exercise on the overhead projector. In part 6 the U shaped wire should swing aside from the magnet when the current is applied. It may be necessary to demonstrate this with a stronger magnet. One of the most serious problems restricting good results with this entire exercise is the influence of magnets which are not part of the experiment. Distance will help to solve this problem.

It was intended that the following things be observed by the students:

Part 1, 2, and 3. Each magnet has at least 2 unlike poles.
4. Any magnet may be used as a compass.
5. A magnet affects an electric current.
6. An electric current affects a magnet.
7. An electric current may be used to produce a magnet.
8. A magnetic field may be used to produce an electric current. This part used the coil wrapped around the compass as a galvanometer. It may be well to demonstrate this using the galvanometer in place of the wire-wrapped coil.
9. The electric motor operates because magnetic fields are produced which attract and/or repel one another at proper time intervals.

To supplement this exercise:

(1) Demonstrate the effect of a magnetic field on a flow of electrons by setting up the Crookes Tube and bringing a magnet near it.
(2) Place a magnet near the oscilloscope to show that the beam is deflected from its original position.

EXERCISE NO. ____________ NAME ________________

Electricity and Magnetism

There are many uses for electricity in home and industry. Except where heat and/or light only are produced, we usually make use of electricity because of its close relationship to magnetism. This exercise will help you to better understand electricity and magnetism and their relationship to one another. You will need to work with someone else to perform some parts of the exercise. Be sure unused magnetic materials are as far as possible from the experimental area so they do not cause undesirable effects on your experiment.

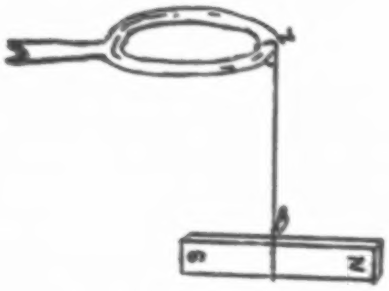
1. Place a piece of heavy paper over a magnet and sprinkle iron filings lightly over the paper. Tap gently. Diagram what you observe.

2. Place two magnets end to end (leave a centimeter or two of space between the ends), place a paper over them and sprinkle the region where the two magnets are close together with iron filings. Diagram what you observe.

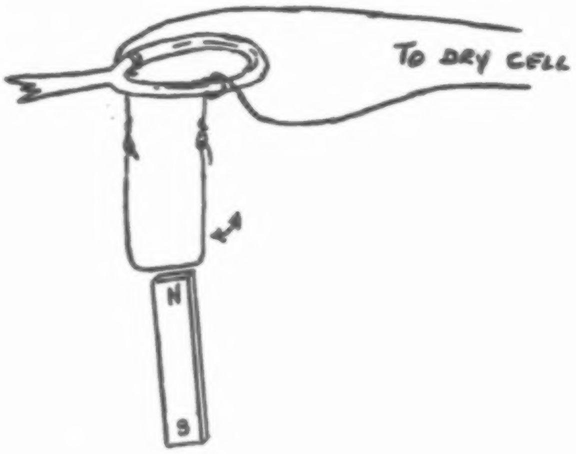
3. Turn one of the two magnets end-for-end and repeat the instructions in #2 above.

4. What evidence do you have that the poles of a magnet are not alike?

5. Tie one end of a string midway between the ends of a bar magnet, suspend it so that the magnet is not near any magnetic materials. When it stops turning, in which direction does it point?

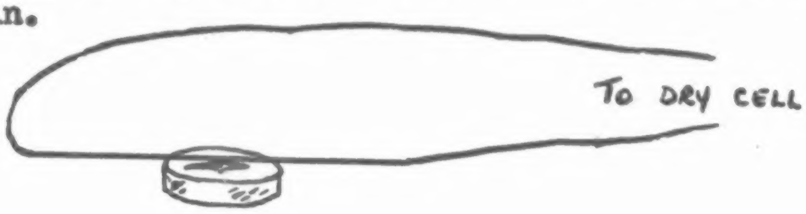


6. Cut a piece of copper wire about 15 centimeters long, bend it in a "U" shape, put and make a hook at each end. Suspend the U by the hooks from two wires that will support it but will allow it to swing freely (be sure all of the connecting points are clean). Place a magnet directly under the suspended wire, connect the free ends of the supporting wires to a dry cell (momentarily) and observe. Describe (if nothing happens you may try a stronger magnet if available).

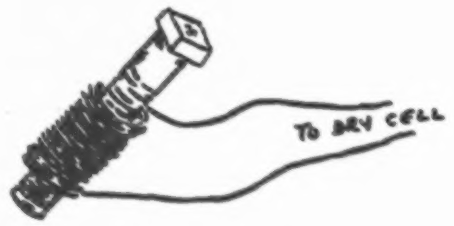


Reverse the magnet. Reverse the connections to the dry cell.

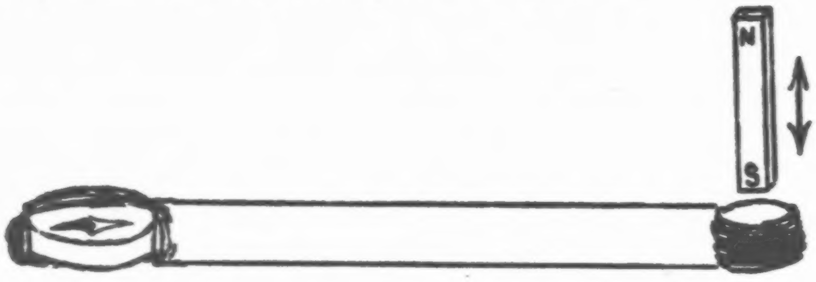
7. Hold a wire lengthwise over a compass needle and touch (momentarily) the free ends of the wire to the terminals of a dry cell. Observe the needle. Explain.



8. Wrap several dozen turns of wire around a bolt. Hold the bolt near a small pile of iron filings and connect the free ends of the wire to the dry cell. Describe what you see.



9. Wrap 25 or 30 turns of wire around the compass. Connect it to a similar coil (use 3 or more feet of wire between coils) through which you can pass a bar magnet. Line up the compass needle with the wires, separate the coils by at least 3 feet and watch the compass needle as you pass a bar magnet rapidly in and out of the connecting coil. Describe what you see. How can you check to see if there is a direct effect (not through the coil) on the compass by the magnet?



10. Suspend one of the magnets as in #5. Bring another magnet near the first so as to repel it and start it turning. See if you can keep the suspend magnet turning in the same direction for some time by repelling and attracting the rotating magnet alternately with the free magnet. This is the principle of the electric motor. What does the electricity do in an electric motor? Could it be called a magnetic motor?

END
3-10-69